

Metal complex, illuminated device and display equipment

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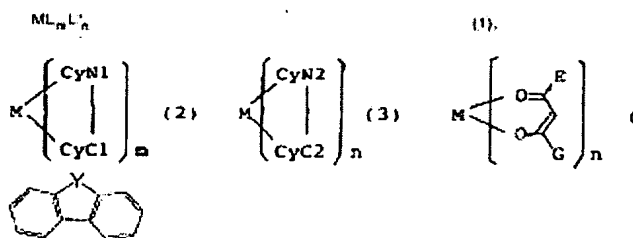
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An electroluminescence device having a layer containing a specific metal coordination compound is provided. The metal coordination compound is represented by formula (1) below: $ML_mL'_n$ wherein M is a metal atom of Ir, Pt, Rh or Pd; L and L' are mutually different bidentate ligands; m is 1, 2 or 3 and n is 0, 1 or 2 with the proviso that $m+n$ is 2 or 3; a partial structure ML_m is represented by formula (2) shown below and a partial structure ML'_n is represented by formula (3) or (4) shown below: <CHEM> at least one of the optional substituent(s) of the cyclic groups, and the cyclic groups CyC1 and CyC2 include an aromatic group capable of having a substituent represented by the following formula (5): <CHEM> The metal coordination compound having the aromatic group is effective in providing high-efficiency luminescence and long-term high luminance.



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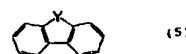
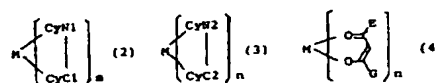
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权利要求书 5 页 说明书 67 页 附图页数 2 页

[54] 发明名称 金属配位化合物, 发光器件和显示设备

[57] 摘要

提供具有包含特定金属配位化合物层的发光器件。该金属配位化合物由通式(1)表示: $ML_mL'_n$ (1), 其中 M 是 Ir、Pt、Rh 或 Pd 的金属原子; L 和 L' 是互相不同的双齿配体; m 是 1、2 或 3 和 n 是 0、1 或 2, 条件是 m + n 是 2 或 3; 部分结构 ML_m 由如下所示的通式(2)表示和部分结构 ML'_n 由如上所示的通式(3)或(4)表示; 环状基团非必要取代基的至少一个, 和环状基团 CyC1 和 CyC2 包括能够含有由如上通式(5)表示的取代基的芳族基团, 含有芳族基团的金属配位化合物可效提供高效率发光和长时间高亮度。



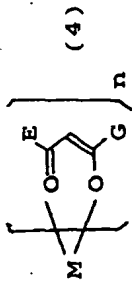
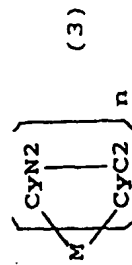
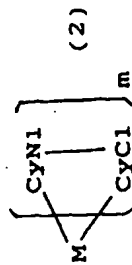
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权 利 要 求 书

1. 一种由以下通式(1)表示的金属配位化合物:



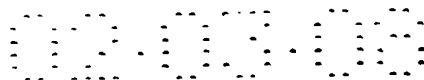
其中 M 是 Ir、Pt、Rh 或 Pd 的金属原子; L 和 L' 是互相不同的双齿配体; m 是 1、2 或 3 和 n 是 0、1 或 2, 条件是 $m+n$ 是 2 或 3; 部分结构 ML_m 由如下所示的通式(2)表示和部分结构 ML'_n 由如下所示的通式(3)或(4)表示:



其中 CyN1 和 CyN2 分别是能够含有取代基、包括氮原子和通过该氮原子键合到所述金属原子 M 上的环状基团; CyC1 和 CyC2 每个是能够含有取代基、包括碳原子和通过该碳原子键合到所述金属原子 M 上的环状基团, 条件是环状基团 CyN1 和环状基团 CyC1 通过共价键彼此键合和环状基团 CyN2 和环状基团 CyC2 通过共价键彼此键合;

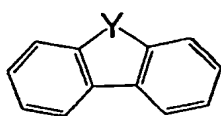
环状基团的任选取代基选自卤原子, 氟基, 硝基, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲基硅烷基, 其烷基可包括一个或非相邻两个或多个可被 -O-, -S-, -CO-, -CO-O-, -O-CO-, -CH=CH- 或 -C≡C- 代替的亚甲基并且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子, 氟基原子, 硝基原子, 其烷基可包括一个或非相邻两个或多个可被 -O-, -S-, -CO-, -CO-O-, -O-CO-, -CH=CH- 或 -C≡C- 代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基)的芳族基团;

E 和 G 独立地是其烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子, 氟基原子, 硝基原子, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基



基甲硅烷基, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基) 的芳族基团; 和

环状基团的任选取代基的至少一个，和环状基团 CyC1 和 CyC2 包括能够含有由如下通式 (5) 表示的取代基的芳族基团：



(5)

其中当通式(5)的芳族基团是所述环状基团的任选取代基时,该芳族基团通过单键键合到CyN1、CyN2、CyC1或CyC2上,和当通式(5)的芳族基团是CyC1或CyC2时,该芳族基团通过单键键合到CyN1或CyN2上并通过单独键合到金属原子M上;

Y 表示 C=O、CRR'、C=C(CN)₂、O 或 S，其中 R 和 R' 独立地是氢原子，含有 1-8 个碳原子的线性或支链烷基，其烷基可包括一个或非相邻两个或多个可被 -O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH- 或 -C≡C- 代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基，或能够含有取代基(即，卤原子，氟原子，硝基原子，其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基，其烷基可包括一个或非相邻两个或多个可被 -O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH- 或 -C≡C- 代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基)的芳族基团；和

通式(5)芳族基团的任选取代基选自卤原子, 氰基, 硝基, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子,

氟原子, 硝基原子, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基且该烷基可包括可任选地被氟原子代替的氢原子的含1-20个碳原子线性或支链烷基)的芳族基团, 条件是相邻对的取代基可以键合以形成环状结构。

2. 根据权利要求1的金属配位化合物, 在通式(1)中包括由通式(3)表示的部分结构 $ML' n$ 。

3. 根据权利要求1的金属配位化合物, 在通式(1)中包括由通式(4)表示的部分结构 $ML' n$ 。

4. 根据权利要求1的金属配位化合物, 其中通式(1)中 n 是0。

5. 根据权利要求1的金属配位化合物, 其中通式(5)中基团 Y 是 $C=O$ 或 CRR' 。

6. 根据权利要求1的金属配位化合物, 其中环状基团 $CyC1$ 和 $CyC2$ 独立地选自苯基、噻吩基、硫茚基、萘基、茈基、9-茚酮基、茚基、二苯并呋喃基、二苯并噻吩基、或卟啉基, 作为能够含有取代基的芳族环状基团, 条件是该芳族环状基团可包括一个或两个可被氟原子代替的 CH 基团。

7. 根据权利要求6的金属配位化合物, 其中环状基团 $CyC1$ 和 $CyC2$ 独立地是苯基或2-茚基。

8. 根据权利要求1的金属配位化合物, 其中环状基团 $CyN1$ 和 $CyN2$ 独立地选自吡啶基、咪唑基、和嘧啶基, 作为能够含有取代基的芳族环状基团。

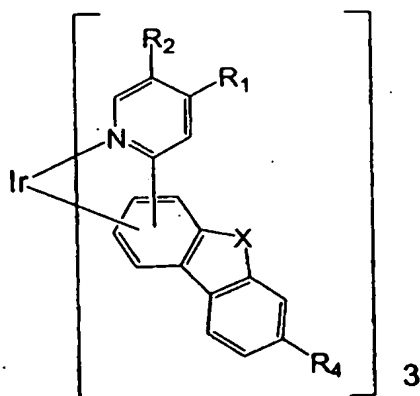
9. 根据权利要求8的金属配位化合物, 其中族环状基团是吡啶基。

10. 根据权利要求1的金属配位化合物, 其中环状基团 $CyN1$ 、 $CyN2$ 、 $CyC1$ 和 $CyC2$ 独立地是非取代的, 或含有选自卤原子和含有1-20个碳原子的线性或支链烷基{其中烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基, 或能够含有取代基(它是卤原子或含有1-20个碳原子的线性或支链烷基(其中烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 和该烷基可包括可任选地被氟原子代替的氢原子))的二价芳族基团, 和该烷基可

包括可任选地被氟原子代替的氢原子}。

11. 根据权利要求 1 的金属配位化合物，其中通式(1)中的 M 是铱。

12. 根据权利要求 1 的金属配位化合物，它由如下通式(6)表示：



其中 X 表示 CRR'、O 或 S，其中 R 和 R' 独立地是通式： C_nH_{2n+1} 的线性或支链烷基，其中 n 是 1-20 的整数，该烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基，和也可包括可任选地被氟原子代替的氢原子；

R₂ 表示氢原子；氟原子；通式： C_nH_{2n+1} 的线性或支链烷基，其中 n 是 1-20 的整数，该烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基，和也可包括可任选地被氟原子代替的氢原子；能够含有取代基的苯基；9,9-二烷基芴基(其中烷基独立地是通式： C_nH_{2n+1} 的线性或支链烷基，其中 n 是 1-20 的整数，该烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基，和也可包括可任选地被氟原子代替的氢原子)；能够含有取代基的二苯并呋喃基；能够含有取代基的二苯并噻吩基；苯基、9,9-二烷基芴基、二苯并呋喃基和二苯并噻吩基的任选取代基是氟原子或通式： C_nH_{2n+1} 的线性或支链烷基，其中 n 是 1-20 的整数，该烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基，和也可包括可任选地被氟原子代替的氢原子。

13. 一种电致发光器件，包括：位于衬底上的一对电极，位于电极之间包括至少一种有机化合物的发光单元，其中有机化合物包括由权利要求 1 中通式(1)表示的金属配位化合物。

14. 根据要求 13 的电致发光器件，其中在电极之间施加电压以发出

光。

15. 根据权利要求 13 的电致发光器件，其中在电极之间施加电压以发出磷光。

16. 一种图象显示设备，包括根据权利要求 13 的电致发光器件，和用于提供电信号到发光器件的装置。

金属配位化合物, 发光器件和显示设备

发明和相关技术领域

本发明涉及用于平面光源, 平面显示器等的有机发光器件(也称为有机电致发光器件或有机 EL 器件)。特别地, 本发明涉及新颖的金属配位化合物和通过使用以后出现的通式(1)表示的金属配位化合物, 具有高发光效率和随时间几乎不发生变化的发光器件。

有机发光器件的较早例子是, 如使用真空沉积膜的发光的器件(薄膜, 94(1982)171)。然而, 近年来, 考虑到优势, 如与无机发光器件相比, 容易提供大面积器件, 和通过各种新材料的开发, 可以实现所需的发光颜色和在低电压下的可驱动性, 对作为具有高速响应和高效率发光器件的器件结构, 已经进行了广泛的研究。

例如, 如准确在 Macromol. Symp. 125, 1-48(1997)中描述的那样, 有机 EL 器件一般含有这样的构造, 该构造包括一对在透明衬底上形成的上电极和下电极, 和包括位于电极之间发光层的有机材料层。

在发光层中, 具有电子-传递特性和发光特性的铝羟基喹啉配合物(包括以下所示作为代表例的 Alq3)用作例子。在空穴-传递层中, 具有给电子性能的材料, 如三苯基二胺衍生物(以下所示作为代表例的 α -NPD)用作例子。

这样的器件显示电流-整流特性, 使得当在电极之间施加电场时, 从正极注入空穴和从负极注入电子。

注入的空穴和电子在发光层复合以形成激发子, 当它们跃迁到基态时发出冷光。

在此过程中, 激发态包括单重态和三重态, 和从前者到基态的跃迁称作荧光和从后者的跃迁称作磷光。在这些状态的材料分别称作单重激发子和三重激发子。

在迄今为止研究的大多数有机发光器件中, 已经采用由单重激发子

到基态的跃迁引起的荧光。另一方面，近年来，已经研究了采用通过三重激发子的磷光的器件。

代表性的公开文献包括：

文章 1：在电致磷光器件中改进的能量传递(D. F. O' Brien, 等, 应用物理快报, 74 卷, No. 3, 422 页(1999)); 和

文章 2：基于电致磷光的非常高效率的绿色有机发光器件(M. A. Baldo, 等, 应用物理快报, 75 卷, No. 1, 4 页(1999))。

在这些文章中，结构包括夹层在电极之间的四个有机层，和其中使用的材料包括载流子传递材料和磷光材料，它们的名称和结构如下所示，以及它们的缩写。

Alq3: 铝羟基喹啉配合物

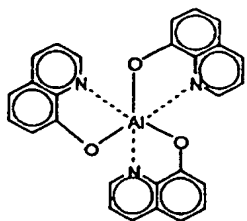
α -NPD: N4, N4' -二苯基-1-基-N4, N4' -二苯基-联苯基-4, 4' -二胺

CBP: 4, 4' -N, N' -二吡啶-联苯基

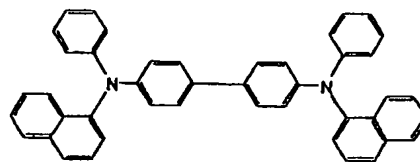
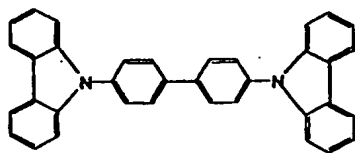
BCP: 2, 9-二甲基-4, 7-二苯基-1, 10-菲咯啉

PtOEP: 铂-八乙基卟啉配合物

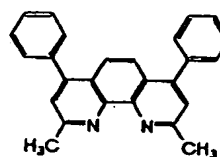
Ir(ppy)₃: 铱-苯基嘧啶配合物



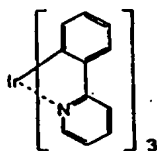
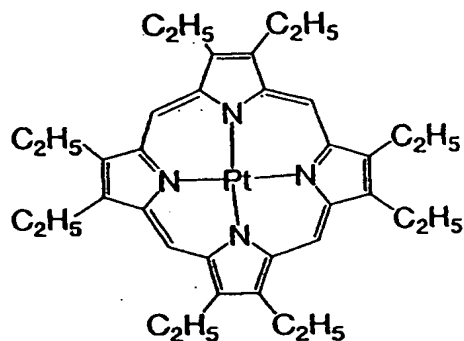
Alq3

 α -NPD

CBP



BCP

Ir(ppy)₃

PtOEP

上述文章 1 和 2 两者都报导了结构，如显示高效率，包括含 α -NPD 的空穴-传递层，含 Alq3 的电子-传递层，含 BCP 的防止激发子扩散层，和含作为主体的 CBP 和作为分散在其中混合物中的磷光材料的约 6% 的 PtOEP 或 Ir(ppy)₃ 的发光层。

目前这样的磷光材料人们特别关注的，这是一般由于基于如下理由，它有望提供高的发光效率。更具体地，通过载流子复合形成的激发子包

括概率比为 1:3 的单重激发子和三重激发子。常规的有机 EL 器件已经采用其发光效率限于至多 25% 的荧光。另一方面，如果采用从三重激发子产生的磷光，可以期望至少三倍的效率，和如果考虑到由于系统间交叉从具有更高能量的单重态到三重态的跃迁，甚至原则上可以期望 100% 的效率，即四倍。

然而，象荧光型器件一样，一般要求改进这样的采用磷光的有机发光器件的发光效率退化和器件稳定性。

退化的原因还没有完全澄清，但基于磷光的机理本发明人考虑如下。

在发光层包括具有载流子-传递功能的主体 (host) 材料和磷光客体 (guest) 材料的情况下，通过三重激发子的发磷光过程可包括如下单元过程：

1. 电子和空穴在发光层中的传递，
2. 主体激发子的形成，
3. 在主体分子之间的激发能量传递，
4. 从主体到客体的激发能量传递，
5. 客体三重激发子的形成，和
6. 客体三重激发子到基态的跃迁和磷光。

引起在每个单元过程中的所需能量传递和发光的竞争并发生各种能量失活过程。

当然，通过增加发光中心材料的发光量子收率，增加有机发光器件的发光效率。

特别地，在磷光材料中，这种情况可能是由于三重激发子的寿命比单重激发子的寿命长三或四位数字。更具体地，由于它保持在高能激发态较长的时间，它易于与周围材料反应和在激发子中引起聚合物的形成，因此招致更高概率的失活过程，导致材料变化或寿命退化。

希望发光器件显示高效率发光和显示高稳定性。特别地，非常希望提供发光材料化合物，在长时间的激发能量态下它较不易于引起能量失活并且也是化学稳定的，因此提供较长的器件寿命。

发明概述

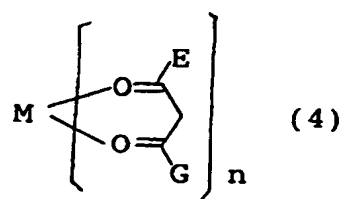
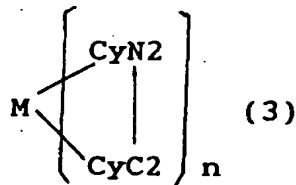
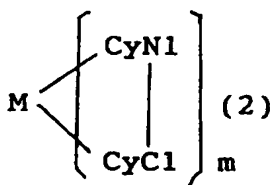
因此, 本发明的主要目的是提供一种发光材料, 它显示高发光效率和保持高亮度较长的时间, 和也提供发光器件和使用该发光器件的显示设备。

在本发明中, 金属配合物用作发光材料, 特别是这样的新颖发光金属配合物化合物, 它包括作为中心金属的铱和以后出现的作为配体的一部分或作为配体的取代基的通式(5)芳族基团。

更具体地, 本发明提供作为发光材料的一种由以下通式(1)表示的金属配位化合物:



其中 M 是 Ir、Pt、Rh 或 Pd 的金属原子; L 和 L' 是互相不同的双齿配体; m 是 1、2 或 3 和 n 是 0、1 或 2, 条件是 m+n 是 2 或 3; 部分结构 ML_m 由如下所示的通式(2)表示和部分结构 ML'_n 由如下所示的通式(3)或(4)表示:



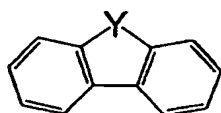
其中 CyN1 和 CyN2 每个是能够含有取代基、包括氮原子和通过该氮原子键合到金属原子 M 上的环状基团; 其中 CyC1 和 CyC2 每个是能够含有取代基, 包括碳原子和通过该碳原子键合到金属原子 M 上的环状基团, 条件是环状基团 CyN1 和环状基团 CyC1 通过共价键彼此键合和环状基团 CyN2 和环状基团 CyC2 通过共价键彼此键合;

环状基团的任选取代基选自卤原子, 氟基, 硝基, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基, 其烷基可包括一个或非相邻两个或多个可被 -O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH- 或 -C≡C- 代替的亚甲基、和其烷基可包括任选地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子, 氟基原子, 硝基原子, 其烷基可包括一个或非相邻两个或多个可被 -O-、-S-、

-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基)的芳族基团;

E 和 G 独立地是其烷基可包括(可任选地被氟原子代替的)氢原子的含 1-20 个碳原子的线性或支链烷基, 或其烷基可包括能够含有取代基(即, 卤原子, 氟原子, 硝基原子, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基、其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子的线性或支链烷基)的芳族基团; 和

环状基团非必要取代基的至少一个, 和环状基团 CyC1 和 CyC2 包括能够含有由如下通式(5)表示的取代基的芳族基团:



(5)

其中当芳族基团是环状基团的非必要取代基时, 通式(5)的芳族基团通过单键键合到 CyN1、CyN2、CyC1 或 CyC2 上, 和当芳族基团是 CyC1 或 CyC2 时, 通式(5)的芳族基团通过单键键合到 CyN1 或 CyN2 上并通过单键键合到金属原子 M 上;

Y 表示 C=O、CRR'、C=C(CN)₂、O 或 S, 其中 R 和 R' 独立地是氢原子, 含有 1-8 个碳原子的线性或支链烷基, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子, 氟原子, 硝基原子, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基)的芳族基团; 和

通式(5)芳族基团的非必要取代基选自卤原子, 氰基, 硝基, 其烷基独立地是含 1-8 个碳原子线性或支链烷基的三烷基甲硅烷基, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基, 或能够含有取代基(即, 卤原子, 氰基原子, 硝基原子, 其烷基可包括一个或非相邻两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基、和其烷基可包括可非必要地被氟原子代替的氢原子的含 1-20 个碳原子线性或支链烷基)的芳族基团, 条件是相邻对的取代基可以键合以形成环状结构。

根据本发明通式(1)金属配位化合物的优选实施方案包括如下:

在通式(1)中含有由通式(3)表示的部分结构 $ML' n$ 的金属配位化合物。

在通式(1)中含有由通式(4)表示的部分结构 $ML' n$ 的金属配位化合物。

金属配位化合物, 其中通式(1)中 n 是 0。

金属配位化合物, 其中通式(5)中基团 Y 是 $C=O$ 或 CRR' 。

金属配位化合物, 其中通式(1)中环状基团 $CyC1$ 和通式(3)中 $CyC2$ 独立地选自作为能够含有取代基的芳族环状基团的苯基、噻吩基、硫茚基、萘基、茚基、9-茚酮基、茚基、二苯并呋喃基、二苯并噻吩基、或卟啉基, 条件是芳族环状基团可包括一个或两个可被氮原子代替的 CH 基团, 特别选自苯基或 2-茚基。

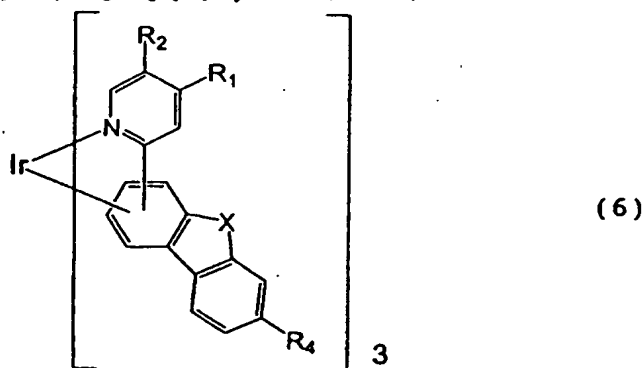
金属配位化合物, 其中环状基团通式(2)中 $CyN1$ 和通式(3)中 $CyN2$ 独立地选自作为能够含有取代基的芳族环状基团的吡啶基、哒嗪基、和嘧啶基, 尤其是吡啶基。

金属配位化合物, 其中环状基团 $CyN1$ 、 $CyN2$ 、 $CyC1$ 和 $CyC2$ 独立地是非取代的, 或含有选自卤原子和含有 1-20 个碳原子的线性或支链烷基 {其中的烷基可包括一个或非相邻的两个或多个可被-O-、-S-、-CO-、-CO-O-、-O-CO-、-CH=CH-或-C≡C-代替的亚甲基, 或能够含有取代基(即

卤原子或含有 1-20 个碳原子的线性或支链烷基(其中的烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 并且该烷基可包括可非必要地被氟原子代替的氢原子))的二价芳族基团, 且所述烷基可包括可非必要地被氟原子代替的氢原子}。

金属配位化合物, 其中通式(1)中的 M 是铱。

由如下通式(6)表示的金属配位化合物:



其中 X 表示 CRR'、O 或 S, 其中 R 和 R' 独立地是通式: C_nH_{2n+1} 的线性或支链烷基, 其中 n 是 1-20 的整数, 烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 并也可包括可非必要地被氟原子代替的氢原子;

R2 表示氢原子; 氟原子; 通式: C_nH_{2n+1} 的线性或支链烷基, 其中 n 是 1-20 的整数, 烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 和也可包括可非必要地被氟原子代替的氢原子; 能够含有取代基的苯基; 9,9-二烷基芴基(其中烷基独立地是通式: C_nH_{2n+1} 的线性或支链烷基, 其中 n 是 1-20 的整数, 烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 和也可包括可非必要地被氟原子代替的氢原子); 能够含有取代基的二苯并呋喃基; 能够含有取代基的二苯并噻吩基; 苯基、9,9-二烷基芴基、二苯并呋喃基和二苯并噻吩基的非必要取代基是氟原子或通式: C_nH_{2n+1} 的线性或支链烷基, 其中 n 是 1-20 的整数, 烷基可包括一个或非相邻两个或多个可被-O-代替的亚甲基, 和也可包括可非必要地被氟原子代替的氢原子。

本发明也提供一种电致发光器件, 包括: 位于衬底上的一对电极, 包括位于电极之间的至少一种有机化合物的发光单元, 其中有机化合物

包括由上述通式(1)表示的金属配位化合物。

在发光器件中，在电极之间施加电压以发出光。

在电致发光器件的优选实施方案中，在电极之间施加电压以发出磷光。

本发明进一步提供一种图象显示设备，包括上述电致发光器件，和用于提供电信号到发光器件的方法或装置。

考虑到如下本发明优选实施方案的描述并结合附图，本发明的这些和其它目的，特点和优点更会是显然的。

附图简述

图 1A, 1B 和 1C 分别说明根据本发明发光器件的实施方案。

图 2 简要说明包括 EL 器件和驱动装置的显示屏结构。

优选实施方案的详细描述

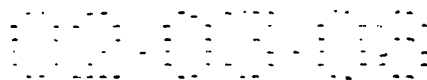
根据本发明形成的有机发光器件的基础结构如图 1A, 1B 和 1C 所示。

如这些图中所示，有机发光器件一般包括，在透明衬底 15 上，50-200nm 厚的透明电极 14，多个有机膜层和覆盖有机层的金属电极 11。

图 1A 显示一个实施方案，其中有机发光器件包括发光层 12 和空穴传递层 13。透明电极 14 可包括 ITO 等，具有较大的功函数以有利于从透明电极 14 到空穴传递层 13 的空穴注入。金属电极 11 包括具有较小功函数的金属材料，如铝、镁或这些元素的合金，以促进有机发光器件的电极注入。

发光层 12 包括根据本发明的化合物(金属配位化合物)。空穴传递层 13 可包括，如三苯基二胺衍生物，如由上述 α -NPD 表示的那些，和如需要也具有给电子性能的材料。

按上述方式构成的器件显示电流-整流特性，和当在作为阴极的金属电极 11 和作为阳极的透明电极 14 之间施加电场时，电子从金属电极 11 注入到发光层 12 中，和从透明电极 15 注入空穴。注入的空穴和电极在发光层 12 中复合以形成具有高能电势的激发子，它在跃迁到基态期间引起发光。在此情况下，空穴传递层 13 作为电子用作电子阻碍层以增加在发光层 12 和空穴传递层 13 之间边界处的复合效率，因此提供增强的发



光效率。

此外，在图 1B 的结构中，电子传递层 16 位于图 1A 的金属电极 11 和发光层 12 之间。结果是，发光功能与电子传递功能和空穴传递功能分离以提供显示更有效载流子阻碍的结构，因此增加了发光效率。电子传递层 16，可包括，如噁二唑衍生物。

图 1C 显示四层结构的另一种所需形式，包括顺序地从作为负极的透明电极 14 侧，空穴传递层 13，发光层 12，防止激发子扩散层 17 和电子传递层 16。

用于本发明的发光材料最合适是由上述通式(1)-(5)表示的金属配位化合物，发现它们引起高效率发光，保持高亮度较长的时间和显示较小的由于电流通过的退化。

本发明的金属配位化合物发出磷光，和认为它的最低激发态是 MLCT* (金属到配体的电荷传递) 激发态或三重态中的 $\pi-\pi^*$ 激发态，和在从这样的状态到基态的跃迁时引起磷光。

此后，会描述一些用于表征本发明发光材料的性能和物理值的测量方法。

(1) 在磷光和荧光之间的判断

根据是否会由氧气引起失活而进行磷光的识别。在以氧气或以氮气通气之后，将样品化合物在氯仿中的溶液进行光照以引起光致发光。如果对于以氧气通气的溶液，几乎没以观察到可归于化合物的发光，但对于以氮气通气的溶液，确认有光致发光，则可以判断为磷光。除非另有说明，本发明所有化合物的磷光已经由此方法确认。

(2) 根据如下公式确定磷光收率(yield)(相对量子收率，即目标样品的量子收率 Φ (样品) 对标准样品量子收率 Φ (st) 的比例)：

$$\Phi(\text{样品})/\Phi(\text{st})=$$

$$[\text{Sem}(\text{样品})/\text{Iabs}(\text{样品})]/[\text{Sem}(\text{st})/\text{Iabs}(\text{st})]$$

其中 $\text{Iabs}(\text{st})$ 表示标准样品在激发波长处的吸收系数； $\text{Sem}(\text{st})$ ，当在相同的波长下激发时的发光光谱面积强度； $\text{Iabs}(\text{样品})$ ，目标化合物在激发波长处的吸收系数；和 $\text{Sem}(\text{样品})$ ，当在相同的波长下激发时的发

光光谱面积强度。

在此描述的磷光收率值是相对于作为标准样品 $\text{Ir}(\text{ppy})_3$ 的磷光收率 $\Phi=1$ 时的相对数值。

(3) 磷光寿命的测量方法如下。

将样品化合物溶于氯仿中和以约 $0.1\mu\text{m}$ 的厚度旋转涂敷在石英衬底上，和通过使用发光寿命测量仪 (Hamamatsu Photonics K.K. 制造)，在室温下，曝露在激发波长为 337nm 的脉冲氦气激光下。在激发脉冲完成之后，测量发光强度的衰减特性。

当初始发光强度由 I_0 表示时，根据如下公式，参考发光寿命 τ (秒)，表示在 t (秒) 之后的发光强度：

$$I = I_0 \cdot \exp(-t/\tau).$$

本发明的发光材料 (金属配位化合物) 显示 $0.11-0.9$ 的高磷光量子收率和 $0.1-40$ 微秒的短磷光寿命。短的磷光寿命成为引起较少能量失活和显示增强的发光效率的条件。更具体地，如果磷光寿命较长，保持用于发光的三重态分子数目增加，和失活过程易于发生，因此导致较低的发光效率，特别是在高电流密度时。本发明材料具有相对短的磷光寿命，因此显示高的磷光量子收率，和因此适于作为 EL 器件的发光材料。

由于我们各种研究的结果，已经发现使用通式 (1) 的金属配位化合物作为主发光材料的有机 EL 器件引起高效率发光，保持高亮度较长的时间和显示较小的由于电流通过的退化。

在表示本发明金属配位化合物的通式 (1) 中， n 可优选为 0 或 1 ，更优选为 0 。此外，部分结构 ML' n 可优选包括由上述通式 (5) 表示的芳族基团。在通式 (5) 中， Y 可优选包括 $\text{C}=\text{O}$ 或 CRR' 。当 Y 是 CRR' ，其中 R 和 R' 是 CH_3 时，通式 (1) 的金属配位化合物可优选不含有取代基。特别地，当 CyC1 是 FL2 (以后出现)，其中 R 和 R' 是 CH_3 和 CyN1 是 Pi 时， $R1-R4$ (作为 Pi 和 FL2 的取代基) 可优选同时是氢原子。

在本发明中，通过将通式 (5) 的芳族基团引入到通式 (1) 的金属配位化合物中，可以控制发射波长 (特别是提供较长的发射波长)。通式 (5) 芳族基团的存在有效地增强了本发明金属配位化合物在有机溶剂中的溶解

性，因此可以通过再结晶或柱色谱对其进行精制。结果是，本发明的金属配位化合物适于作为用于有机 EL 器件的发光材料。

此外，如在此后出现的实施例中所示，已经证实本发明的金属配位化合物在连续的电流通过测试中显示优异的稳定性。这种情况可归于根据本发明通式(1)金属配位化合物中通式(5)芳族基团的引入。更具体地，由于通式(5)芳族基团的引入，分子间相互作用的变化允许金属配位化合物与，如主体材料的分子间相互作用，以抑制引起热失活激发子缔合物 (exciton associates) 的形成，这样减少了猝灭过程因此改进了磷光收率和器件特性。

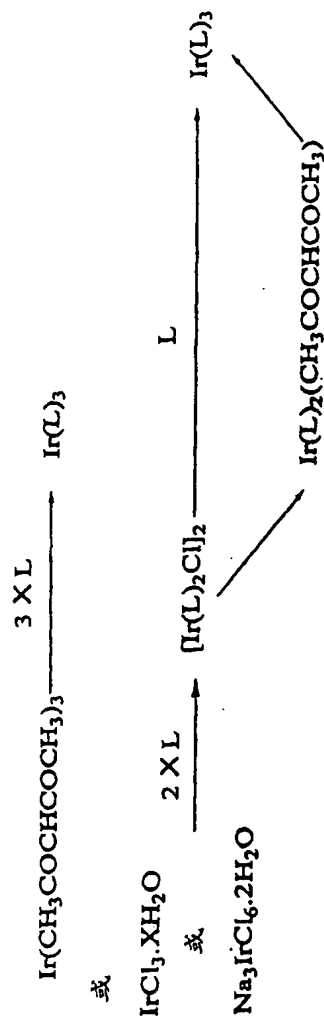
根据本发明的发光器件可优选是电致发光器件的以下类型，其中通式(1)金属配位化合物的层位于相对的两个电极之间和在电极之间施加电压以引起发光，如图 1A, 1B 和 1C 所示。

对于显示器的用途，可以使用这样的驱动系统，它使用根据有源矩阵方案的薄膜晶体管(TFT)驱动电路。此后，参见图 2，简要描述使用本发明器件结合有源主体衬底的实施方案。

图 2 说明包括 EL 器件和驱动机构的显示屏结构的实施方案。显示屏含有扫描信号驱动器，数据信号驱动器和电流源，它分别连接到栅 (gate) 选择线，数据信号线和电流供应线。在栅选择线和数据信号线的每个交叉点，放置显示象素电极。扫描信号驱动器顺序选择栅选择线 G1, G2, G3...Gn, 和与之同步，从数据信号驱动器提供画面信号以显示图画(图象)。

通过驱动包括含有本发明的发光材料的发光层的显示屏，可以提供显示良好图象质量的显示器和甚至在长时间显示时显示器是稳定的。

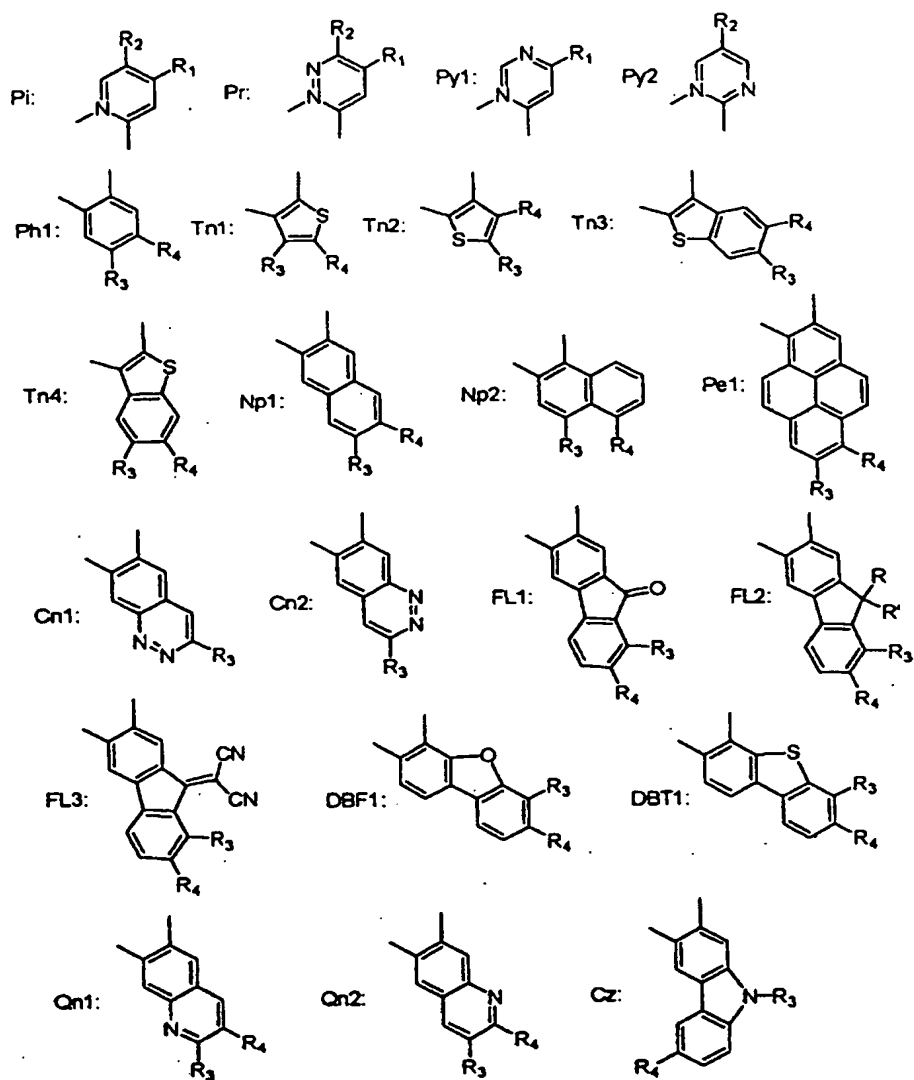
参考铱配位化合物 ($m+n=3$) 为例，以下说明用于提供由上述通式(1)表示的金属配位化合物的一些合成途径：



也可以采用相似的方式合成其它金属配位化合物 (M=Pt、Rh 和 Pd)。

用于本发明金属配位化合物的一些具体结构例子见以后出现的表 1 到表 42, 然而这些例子仅是说明性例子而不是穷举。

用于表 1-42 中所示 CyN1、CyN2、CyC1 和 CyC2 的 Pi 到 Cz 表示如下所示的部分结构。



此外，作为用于表 1-42 中所示 CyN1、CyN2、CyC1 和 CyC2 的取代基的芳族基团 Ph2 到 DBT3 表示如下所示的部分结构，条件是当芳族基团的取代基 R5 到 R8 没有特别指出时，它们表示氢原子。

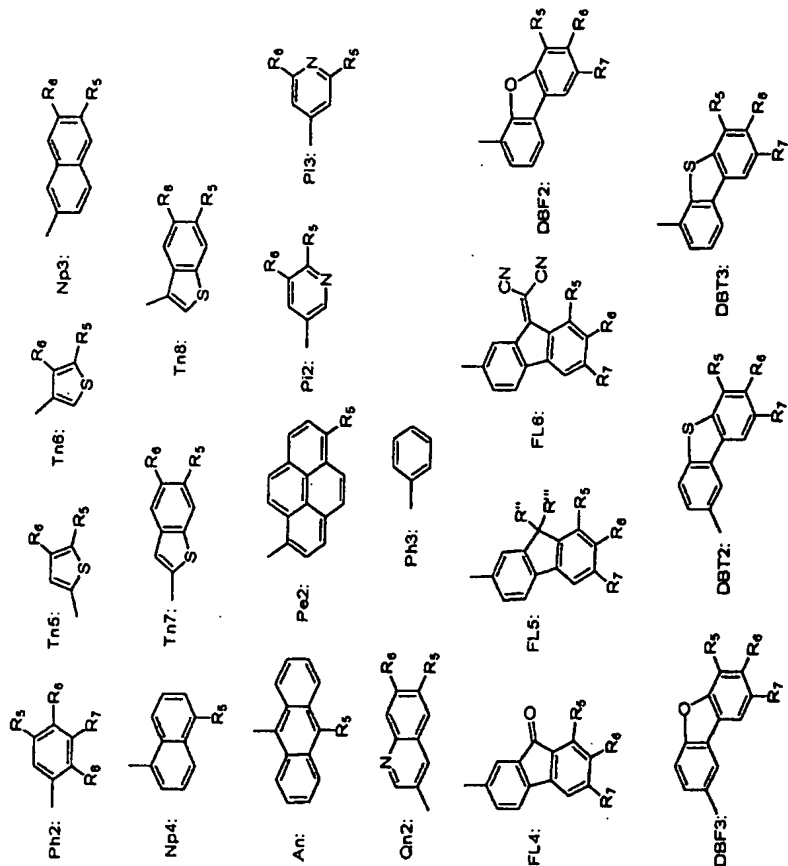


表 1

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|-----------------|-----------------|-----------------|--------------------------------|------|-------------------------------|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 1 | Ir | 3 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 2 | Ir | 3 | 0 | Pi | FL1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 3 | Ir | 3 | 0 | Pi | FL1 | - | - | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 4 | Ir | 3 | 0 | Pi | FL1 | - | - | H | CH ₃ | - | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 5 | Ir | 3 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| 6 | Ir | 3 | 0 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 7 | Ir | 3 | 0 | Pi | FL1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 8 | Ir | 3 | 0 | Pi | FL1 | - | - | H | FL6 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 9 | Ir | 3 | 0 | Pi | FL1 | - | - | H | DBF2 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 10 | Ir | 3 | 0 | Pi | FL1 | - | - | H | DBT3 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 11 | Ir | 3 | 0 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 12 | Ir | 3 | 0 | Pi | FL1 | - | - | H | Ph2 | H | C ₃ H ₇ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 13 | Ir | 3 | 0 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 14 | Ir | 3 | 0 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 15 | Ir | 3 | 0 | Pi | FL1 | - | - | H | Tn7 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 16 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 2

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|--------------------------------|--------------------------------|-----------------|--------------------------------|------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 17 | Ir | 3 | 0 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 18 | Ir | 3 | 0 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 19 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| 20 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | FL5 | H | H | H | H | - |
| 21 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 22 | Ir | 3 | 0 | Pi | Np2 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 23 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 24 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 25 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 26 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | CH ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 27 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| 28 | Ir | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 29 | Ir | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 30 | Ir | 3 | 0 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 31 | Ir | 3 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 32 | Ir | 3 | 0 | Pi | FL2 | C ₆ H ₁₃ | C ₆ H ₁₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 3

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|--------------------------------|------|----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 33 | Ir | 3 | 0 | Pi | FL2 | C ₇ H ₁₅ | C ₇ H ₁₅ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 34 | Ir | 3 | 0 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 35 | Ir | 3 | 0 | Pi | FL2 | C ₁₀ H ₂₁ | C ₁₀ H ₂₁ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 36 | Ir | 3 | 0 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| 37 | Ir | 3 | 0 | Pi | FL2 | C ₂₀ H ₄₁ | C ₂₀ H ₄₁ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 38 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 39 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 40 | Ir | 3 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 41 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 42 | Ir | 3 | 0 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 43 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 44 | Ir | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| 45 | Ir | 3 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 46 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| 47 | Ir | 3 | 0 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| 48 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |

表 4

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|-----------------|---|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 49 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| 50 | Ir | 3 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 51 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL6 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 52 | Ir | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | DBF2 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 53 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBT3 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 54 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 55 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | CF ₃ | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 56 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 57 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 58 | Ir | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 59 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn6 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 60 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 61 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 62 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn7 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 63 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 64 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | An | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 5

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|-------------------------------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 65 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Pe2 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 66 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Pi2 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 67 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Pi3 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 68 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Qn2 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 69 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 70 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | An | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 71 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 72 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 73 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | Ph3 | Ph3 | H | Ph2 | H | H | H | H |
| 74 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | Ph3 | H | Ph2 | H | H | H | H |
| 75 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | Ph3 | H | Ph2 | H | H | H | H |
| 76 | Ir | 3 | 0 | Pi | FL2 | (CH ₂) ₃ Ph3 | (CH ₂) ₃ Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 77 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn5 | C ₃ H ₇ | H | - | - |
| 78 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn6 | H | H | - | - |
| 79 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Np3 | H | H | - | - |
| 80 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Np4 | H | - | - | - |

表 6

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|----|----|---|---|------|------|--------------------------------|--------------------------------|---------|---------|-------------------------------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 81 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | Ph3 | H | Tn7 | H | H | - | - |
| 82 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| 83 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | An | H | - | - | - |
| 84 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Pe2 | H | - | - | - |
| 85 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | Ph3 | H | Pi2 | C ₂ H ₅ | H | - | - |
| 86 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Pi3 | H | H | - | - |
| 87 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Qn2 | H | H | - | - |
| 88 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | DBT3 | H | H | - | - |
| 89 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 90 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 91 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | CF3 | - | - | - | - |
| 92 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 93 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| 94 | Ir | 3 | 0 | Pi | Tn1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 95 | Ir | 3 | 0 | Pi | Tn2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 96 | Ir | 3 | 0 | Pi | Tn3 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |

表 7

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-----------------|-----------------|---------|---------|------|------|---------|---------|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 97 | Ir | 3 | 0 | Pi | Tn4 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 98 | Ir | 3 | 0 | Pi | Np1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 99 | Ir | 3 | 0 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 100 | Ir | 3 | 0 | Pi | Pe1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 101 | Ir | 3 | 0 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 102 | Ir | 3 | 0 | Pi | Pe2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 103 | Ir | 3 | 0 | Pi | Cn1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | - | - | - | - | - |
| 104 | Ir | 3 | 0 | Pi | Cn2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | - | - | - | - | - |
| 105 | Ir | 3 | 0 | Pi | FL3 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 106 | Ir | 3 | 0 | Pi | DBF1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 107 | Ir | 3 | 0 | Pi | DBT1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 108 | Ir | 3 | 0 | Pi | Qn1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 109 | Ir | 3 | 0 | Pi | Qn2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 110 | Ir | 3 | 0 | Pi | Cz | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | Ph3 | H | - | - | - | - |
| 111 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 112 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn5 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |

表 8

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|---------|---------|------|----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 113 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn6 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 114 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 115 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np4 | FL5 | - | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 116 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | Tn7 | FL5 | H | - | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 117 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn8 | FL5 | H | - | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 118 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | An | FL5 | - | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 119 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Pe2 | FL5 | - | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 120 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Qn2 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 121 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 122 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 123 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL6 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 124 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBF2 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 125 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBF3 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 126 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBT2 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 127 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBT3 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 128 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₆ H ₁₇ | C ₆ H ₁₇ | FL5 | H | H | H | H | - |

表 9

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|---------|---------|------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 129 | Ir | 3 | 0 | Pi | Tn1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 130 | Ir | 3 | 0 | Pi | Tn2 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 131 | Ir | 3 | 0 | Pi | Tn3 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 132 | Ir | 3 | 0 | Pi | Tn4 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 133 | Ir | 3 | 0 | Pi | Np2 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 134 | Ir | 3 | 0 | Pi | Pe1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 135 | Ir | 3 | 0 | Pi | Cn1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | - | H | H | H | - |
| 136 | Ir | 3 | 0 | Pi | Cn2 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | - | H | H | H | - |
| 137 | Ir | 3 | 0 | Pi | FL3 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 138 | Ir | 3 | 0 | Pi | DBF1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 139 | Ir | 3 | 0 | Pi | DBT1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 140 | Ir | 3 | 0 | Pi | Qn1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | Ph3 | FL5 | H | H | H | H | - |
| 141 | Ir | 3 | 0 | Pi | Qn2 | - | - | H | H | - | - | - | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | FL5 | H | H | H | H | - |
| 142 | Ir | 3 | 0 | Pi | Cz | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 143 | Ir | 3 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 144 | Ir | 3 | 0 | Pi | FL3 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 10

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-----------------|-----------------|-----------------|-----------------|------|-----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 145 | Ir | 3 | 0 | Pi | FL3 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 146 | Ir | 3 | 0 | Pi | DBF1 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 147 | Ir | 3 | 0 | Pi | DBT1 | CH ₃ | CH ₃ | H | CH ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 148 | Ir | 3 | 0 | Pi | FL3 | - | - | H | FL6 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 149 | Ir | 3 | 0 | Pi | DBF1 | - | - | H | DBF2 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 150 | Ir | 3 | 0 | Pi | DBT1 | - | - | H | DBT3 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 151 | Rh | 3 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 152 | Rh | 3 | 0 | Pi | FL1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 153 | Rh | 3 | 0 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 154 | Rh | 3 | 0 | Pi | FL1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 155 | Rh | 3 | 0 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 156 | Rh | 3 | 0 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 157 | Rh | 3 | 0 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 158 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 159 | Rh | 3 | 0 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 160 | Rh | 3 | 0 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |

表 11

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|-----------------|--------------------------------|------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 161 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| 162 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 163 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 164 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 165 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 166 | Rh | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 167 | Rh | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 168 | Rh | 3 | 0 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 169 | Rh | 3 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 170 | Rh | 3 | 0 | Pi | FL2 | C ₆ H ₁₃ | C ₆ H ₁₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 171 | Rh | 3 | 0 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| 172 | Rh | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 173 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 174 | Rh | 3 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 175 | Rh | 3 | 0 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 176 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |

表 12

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|-----------------|----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 177 | Rh | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| 178 | Rh | 3 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 179 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| 180 | Rh | 3 | 0 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| 181 | Rh | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 182 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| 183 | Rh | 3 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 184 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL6 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 185 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 186 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | CF ₃ | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 187 | Rh | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 188 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 189 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 190 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 191 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | An | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 192 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Pe2 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 13

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|-------------------------------|-----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 193 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 194 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 195 | Rh | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | Ph3 | Ph3 | H | Ph2 | H | H | H | H |
| 196 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | Ph3 | H | Ph2 | H | H | H | H |
| 197 | Rh | 3 | 0 | Pi | FL2 | (CH ₂) ₃ Ph3 | (CH ₂) ₃ Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 198 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn5 | C ₃ H ₇ | H | - | - |
| 199 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 200 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 201 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | CF3 | - | - | - | - |
| 202 | Rh | 3 | 0 | Pi | Tn4 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 203 | Rh | 3 | 0 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 204 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 205 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn5 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 206 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn6 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 207 | Rh | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 208 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | FL5 | H | H | H | H | - |

表 14

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------|-------------------------------|---------|-----------------|------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 209 | Rh | 3 | 0 | Pi | Tn1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 210 | Rh | 3 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 211 | Pt | 2 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 212 | Pt | 2 | 0 | Pi | FL1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 213 | Pt | 2 | 0 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 214 | Pt | 2 | 0 | Pi | FL1 | - | - | H | DBT3 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 215 | Pt | 2 | 0 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 216 | Pt | 2 | 0 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 217 | Pt | 2 | 0 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 218 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 219 | Pt | 2 | 0 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 220 | Pt | 2 | 0 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 221 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| 222 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | FL5 | H | H | H | H | - |
| 223 | Pt | 2 | 0 | Pi | Np2 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 224 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 15

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|-----------------|-----------------|-----------------|---|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 225 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 226 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 227 | Pt | 2 | 0 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 228 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 229 | Pt | 2 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 230 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 231 | Pt | 2 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 232 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| 233 | Pt | 2 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 234 | Pt | 2 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 235 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 236 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | CF ₃ | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 237 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 238 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 239 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | Ph3 | H | An | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 240 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |

表 16

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|-------------------------------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 241 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 242 | Pt | 2 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | Ph3 | Ph3 | H | Ph2 | H | H | H | H |
| 243 | Pt | 2 | 0 | Pi | FL2 | (CH ₂) ₃ Ph3 | (CH ₂) ₃ Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 244 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn5 | C ₃ H ₇ | H | - | - |
| 245 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | DBT3 | H | H | - | - |
| 246 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 247 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 248 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | CF3 | - | - | - | - |
| 249 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 250 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| 251 | Pt | 2 | 0 | Pi | Tn1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 252 | Pt | 2 | 0 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| 253 | Pt | 2 | 0 | Pi | Pe2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 254 | Pt | 2 | 0 | Pi | Cn1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | - | - | - | - | - |
| 255 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 256 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn5 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |

表 17

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|-----------------|-----------------|------|-----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 257 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn6 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 258 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 259 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 260 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL6 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 261 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBF2 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 262 | Pt | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | DBF3 | FL5 | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 263 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | FL5 | H | H | H | H | - |
| 264 | Pt | 2 | 0 | Pi | Tn1 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 265 | Pt | 2 | 0 | Pi | Tn2 | - | - | H | H | - | - | - | - |
| | | | | | | CH ₃ | CH ₃ | FL5 | H | H | H | H | - |
| 266 | Pt | 2 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 267 | Pt | 2 | 0 | Pi | FL3 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 268 | Pt | 2 | 0 | Pi | FL3 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 269 | Pt | 2 | 0 | Pi | DBF1 | - | - | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 270 | Pt | 2 | 0 | Pi | DBT1 | - | - | H | CH ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 271 | Pd | 2 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 272 | Pd | 2 | 0 | Pi | FL1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 18

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|-----------------|------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 273 | Pd | 2 | 0 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 274 | Pd | 2 | 0 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 275 | Pd | 2 | 0 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 276 | Pd | 2 | 0 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 277 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 278 | Pd | 2 | 0 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 279 | Pd | 2 | 0 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 280 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| 281 | Pd | 2 | 0 | Pi | Np2 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 282 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 283 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 284 | Pd | 2 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 285 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 286 | Pd | 2 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 287 | Pd | 2 | 0 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 288 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |

表 19

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|---------|-----------------|-----------------|-----|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 289 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | CF ₃ | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| 290 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 291 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| 292 | Pd | 2 | 0 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | Ph3 | H | - |
| | | | | | | Ph3 | Ph3 | H | Ph2 | H | H | H | H |
| 293 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | DBT3 | H | H | - | - |
| 294 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 295 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | H | H | - | - | - | - |
| 296 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 297 | Pd | 2 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn5 | FL5 | H | - | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 298 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | FL5 | H | H | H | H | - |
| 299 | Pd | 2 | 0 | Pi | Ph1 | - | - | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| 300 | Pd | 2 | 0 | Pi | DBT1 | - | - | H | CH ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 20

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-----|------|---------|---------|------|-----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | |
| | | | | CyC2 | | | | R5 | R6 | R7 | R8 | | |
| 301 | Ir | 2 | 1 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 302 | Ir | 2 | 1 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 303 | Ir | 2 | 1 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 304 | Ir | 2 | 1 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 305 | Ir | 2 | 1 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 306 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 307 | Ir | 2 | 1 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 308 | Ir | 2 | 1 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 309 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 310 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 21

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|-----------------|--------------------------------|------|----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | |
| | | | | CyC2 | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 311 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 312 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 313 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 314 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 315 | Ir | 2 | 1 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 316 | Ir | 2 | 1 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 317 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 318 | Ir | 2 | 1 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 319 | Ir | 2 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 320 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |

表 22

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | |
|-----|----|---|---|------|------|-------------------------------|-------------------------------|--------------------------------|---------|---------|---|----|----|----|----|
| | | | | | | R'' | R''' | | | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | |
| | | | | | | R'' | R''' | | | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | | | |
| | | | | | | | | | | CyC2 | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | | | |
| 321 | Ir | 2 | 1 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - | | |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - | | |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 322 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 323 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Py1 | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 324 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 325 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | CH ₃ | H | - | - | - | - | | |
| 326 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | Br | H | - | - | - | - | | |
| 327 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | CF ₃ | H | - | - | - | - | | |
| 328 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - | | |
| 329 | Ir | 2 | 1 | Pi | Np2 | - | - | H | FL5 | H | H | H | - | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - | | |
| 330 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | Cl | H | - | - | - | - | | |

表 23

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|-----------------|--------------------------------|------|----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyN2 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC2 | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 331 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 332 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 333 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| | | | | Pi | Tn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 334 | Ir | 2 | 1 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn3 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | CH ₃ | - | - | - | - |
| 335 | Ir | 2 | 1 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn4 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 336 | Ir | 2 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Np1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 337 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Np2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 338 | Ir | 2 | 1 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| | | | | Pi | Pe1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 339 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Cn1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | - | - | - | - | - |
| 340 | Ir | 2 | 1 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Cn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | - | - | - | - | - |

CONCLUSIONS

39

表 25

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------|-------------------------------|--------------------------------|---------|------|---|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | R | R' | CyC2-R3 | CyC2-R4 | CyN2 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | CyC2 | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 351 | Ir | 2 | 1 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | Pr | Qn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 352 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pr | Cz | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Ph3 | H | - | - | - | - |
| 353 | Rh | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 354 | Rh | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 355 | Rh | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CH ₃ | H | - | - | - | - |
| 356 | Rh | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Br | H | - | - | - | - |
| 357 | Rh | 2 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CF ₃ | H | - | - | - | - |
| 358 | Rh | 2 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - |
| 359 | Rh | 2 | 1 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - |
| 360 | Rh | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |

表 26

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|----|----|------|------|------|------|---------|---------|------|-----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | CyC1 | | | | CyC1 | | | |
| | | | | | | R | R' | CyN2-R1 | CyN2-R2 | R5 | R6 | R7 | R8 |
| | | | | | | CyN2 | | | | CyN2 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | CyC2 | | | |
| R5 | R6 | R7 | R8 | | | | | | | | | | |
| 361 | Ir | 1 | 2 | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 362 | Ir | 1 | 2 | Pi | FL1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 363 | Ir | 1 | 2 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 364 | Ir | 1 | 2 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 365 | Ir | 1 | 2 | Pi | FL1 | - | - | H | Np4 | H | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 366 | Ir | 1 | 2 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 367 | Ir | 1 | 2 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 368 | Ir | 1 | 2 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 369 | Ir | 1 | 2 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 370 | Ir | 1 | 2 | Pi | Ph1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 27

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|-----------------|--------------------------------|------|----|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | |
| | | | | | | | | | | CyC2 | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 371 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 372 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 373 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 374 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 375 | Ir | 1 | 2 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 376 | Ir | 1 | 2 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 377 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 378 | Ir | 1 | 2 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 379 | Ir | 1 | 2 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 380 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |

表 28

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | | | |
|-----|----|---|---|------|------|-------------------------------|-------------------------------|--------------------------------|---------|---------|---|---------|---------|------|----|----|----|
| | | | | | | R'' | R''' | | | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 | | |
| | | | | | | CyC1 | | | | R5 | R6 | R7 | R8 | | | | |
| | | | | | | CyN2 | CyC2 | | | R | R' | CyN2-R1 | CyN2-R2 | CyN2 | | | |
| | | | | | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | CyC2 | | | | | | | | | |
| | | | | | | | | R5 | R6 | R7 | R8 | | | | | | |
| 381 | Ir | 1 | 2 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - | | | | |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - | | | | |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 382 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 383 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Py1 | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 384 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 385 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | CH ₃ | H | - | - | - | - | | | | |
| 386 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | Br | H | - | - | - | - | | | | |
| 387 | Ir | 1 | 2 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | CF ₃ | H | - | - | - | - | | | | |
| 388 | Ir | 1 | 2 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - | | | | |
| 389 | Ir | 1 | 2 | Pi | Np2 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - | | | | |
| 390 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | Cl | H | - | - | - | - | | | | |

表 29

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | |
|-----|----|----|----|------|------|-------------------------------------|-------------------------------------|-----------------|--------------------------------|---------|---------|----|----|----|----|
| | | | | | | R'' | R''' | | | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | |
| | | | | | | R'' | R''' | | | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | CyN2 | | | | | | | | | |
| | | | | | | CyC2 | | | | | | | | | |
| R5 | R6 | R7 | R8 | | | | | | | | | | | | |
| 391 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Tn1 | - | - | H | CF ₃ | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 392 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Tn1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 393 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - | | |
| | | | | Pi | Tn2 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 394 | Ir | 1 | 2 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Tn3 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | CH ₃ | - | - | - | - | | |
| 395 | Ir | 1 | 2 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Tn4 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 396 | Ir | 1 | 2 | Pi | FL2 | H | H | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Np1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 397 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Np2 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 398 | Ir | 1 | 2 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | FL5 | H | H | H | - | | |
| | | | | | | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - | | |
| | | | | Pi | Pe1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 399 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - | | |
| | | | | Pi | Cn1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | - | - | - | - | - | | |
| 400 | Ir | 1 | 2 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Cn2 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | - | - | - | - | - | | |

表 30

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | |
|-----|----|----|----|------|------|-------------------------------------|-------------------------------------|---------|---------|---------|---------|----|----|----|----|
| | | | | | | R'' | R''' | | | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | |
| | | | | | | R'' | R''' | | | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | CyN2 | | | | | | | | | |
| | | | | | | CyC2 | | | | | | | | | |
| R5 | R6 | R7 | R8 | | | | | | | | | | | | |
| 401 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | DBT3 | H | H | H | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 402 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 403 | Ir | 1 | 2 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 404 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | H | H | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 405 | Ir | 1 | 2 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 406 | Ir | 1 | 2 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 407 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | FL3 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 408 | Ir | 1 | 2 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | DBF1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 409 | Ir | 1 | 2 | Pi | FL2 | H | H | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | DBT1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 410 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | Pi | Qn1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | Cl | H | - | - | - | - | | |

表 31

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|------|---------|---------|------|------|-------------------------------|-------------------------------|--------------------------------|---------|------|---|---|---|
| | | | | | | R5 | R6 | | | R7 | R8 | | |
| | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | | | |
| | | | | R5 | R6 | | | R7 | R8 | | | | |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyN2 | | | |
| | | | | | | R5 | R6 | | | R7 | R8 | | |
| R'' | R''' | CyC2-R3 | CyC2-R4 | CyC2 | | | | | | | | | |
| R5 | R6 | | | R7 | R8 | | | | | | | | |
| 411 | Ir | 1 | 2 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | Pr | Qn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 412 | Ir | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pr | Cz | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Ph3 | H | - | - | - | - |
| 413 | Rh | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 414 | Rh | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 415 | Rh | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CH ₃ | H | - | - | - | - |
| 416 | Rh | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Br | H | - | - | - | - |
| 417 | Rh | 1 | 2 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CF ₃ | H | - | - | - | - |
| 418 | Rh | 1 | 2 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - |
| 419 | Rh | 1 | 2 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - |
| 420 | Rh | 1 | 2 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |

表 32

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | |
|------|----|---|---|------|------|--------------------------------|--------------------------------|-----------------|--------------------------------|---------|---------|----|----|----|----|
| | | | | | | R'' | R''' | | | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | |
| | | | | | | R'' | R''' | | | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | CyN2 | | | | | | | | | |
| CyC2 | | | | | | | | | | | | | | | |
| 421 | Pt | 1 | 1 | Pi | FL1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 422 | Pt | 1 | 1 | Pi | FL1 | - | - | H | FL4 | H | H | H | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 423 | Pt | 1 | 1 | Pi | FL1 | - | - | H | Ph2 | H | H | H | H | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 424 | Pt | 1 | 1 | Pi | FL1 | - | - | H | FL4 | H | Ph3 | H | - | | |
| | | | | | | - | - | H | Ph2 | H | H | H | H | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 425 | Pt | 1 | 1 | Pi | FL1 | - | - | H | Np4 | H | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 426 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 427 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 428 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 429 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| 430 | Pt | 1 | 1 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |
| | | | | | | - | - | H | H | - | - | - | - | | |

表 33

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|-----------------|--------------------------------|------|---|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | |
| | | | | | | | | | | CyC2 | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 431 | Pt | 1 | 1 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 432 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pr | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 433 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Py1 | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 434 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 435 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CH ₃ | H | - | - | - | - |
| 436 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn1 | - | - | H | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 437 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | CF ₃ | CF ₃ | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 438 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - |
| | | | | Pi | Tn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 439 | Pt | 1 | 1 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn3 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | CH ₃ | - | - | - | - |
| 440 | Pt | 1 | 1 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Tn4 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |

表 34

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|------|------|---------|---------|---------|---------|-------------------------------------|-------------------------------------|-----------------|---------|------|---|----|----|
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | | | |
| | | | | | | R5 | R6 | R7 | R8 | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| R | R' | CyC1-R3 | CyC1-R4 | CyN2 | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| R | R' | CyC2-R3 | CyC2-R4 | CyC2 | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 441 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | DBT3 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | FL1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 442 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 443 | Pt | 1 | 1 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 444 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | H | H | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 445 | Pt | 1 | 1 | Pi | FL2 | C ₈ H ₁₇ | C ₈ H ₁₇ | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 446 | Pt | 1 | 1 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | H | FL5 | H | H | H | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | H | H | - | - | - | - |
| | | | | Pr | Qn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 447 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pr | Cz | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Ph3 | H | - | - | - | - |
| 448 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 449 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Py2 | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 450 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CH ₃ | H | - | - | - | - |

表 35

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|---------|---------|------|-----|----|----|
| | | | | | | R5 | R6 | | | R7 | R8 | | |
| | | | | CyN2 | CyC2 | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | R5 | R6 | | | R7 | R8 | | |
| | | | | | | R | R' | CyN2-R1 | CyN2-R2 | CyN2 | | | |
| | | | | | | R'' | R''' | | | R5 | R6 | R7 | R8 |
| | | | | CyC2 | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | |
| 451 | Pt | 1 | 1 | Pi | Ph1 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 452 | Pt | 1 | 1 | Pi | Np2 | - | - | H | FL4 | H | H | H | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 453 | Pt | 1 | 1 | Pi | FL1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 454 | Pt | 1 | 1 | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | FL4 | H | H | H | H | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 455 | Pt | 1 | 1 | Pi | Ph1 | - | - | H | Ph2 | H | FL4 | H | H |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 456 | Pt | 1 | 1 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 457 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 458 | Pt | 1 | 1 | Pi | FL2 | (CH ₂) ₃ Ph3 | (CH ₂) ₃ Ph3 | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 459 | Pt | 1 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 460 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |

表 36

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|--------------------------------|---------|------|-----|----|----|
| | | | | | | R'' | R''' | | | R5 | R6 | R7 | R8 |
| | | | | | | CyN2 | CyC2 | CyN2-R1 | CyN2-R2 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyN2 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC2 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 461 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Br | H | - | - | - | - |
| 462 | Pt | 1 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | CF ₃ | H | - | - | - | - |
| 463 | Pt | 1 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - |
| 464 | Pt | 1 | 1 | Pi | Np2 | - | - | H | FL5 | H | H | H | - |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - |
| 465 | Pt | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | Cl | H | - | - | - | - |
| 466 | Pd | 1 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Np1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 467 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Np2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 468 | Pd | 1 | 1 | Pi | FL2 | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | FL5 | H | H | H | - |
| | | | | | | C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | H | - | - | - | - |
| | | | | Pi | Pe1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 469 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - |
| | | | | Pi | Cn1 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | - | - | - | - | - |
| 470 | Pd | 1 | 1 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | Pi | Cn2 | - | - | H | H | - | - | - | - |
| | | | | | | - | - | H | - | - | - | - | - |

表 37

表 37

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | | | |
|-----|----|---|---|------|------|-------------------------------------|-------------------------------------|--------------------------------|---------|------|-----|----|----|------|--|--|--|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 | | | | |
| | | | | CyN2 | CyC2 | R | R' | CyN2-R1 | CyN2-R2 | CyC1 | | | | | | | |
| | | | | | | R'' | R''' | CyC2-R3 | CyC2-R4 | R5 | R6 | R7 | R8 | | | | |
| | | | | | | | | | | | | | | CyN2 | | | |
| | | | | | | | | | | | | | | CyC2 | | | |
| | | | | | | | | R5 | R6 | R7 | R8 | | | | | | |
| 471 | Pd | 1 | 1 | Pi | FL2 | Ph3 | Ph3 | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 472 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Pi | FL3 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 473 | Pd | 1 | 1 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | Pi | DBF1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 474 | Pd | 1 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | DBT1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| 475 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | Qn1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | Cl | H | - | - | - | - | | | | |
| 476 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | Tn8 | H | H | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | Br | H | - | - | - | - | | | | |
| 477 | Pd | 1 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | CF ₃ | H | - | - | - | - | | | | |
| 478 | Pd | 1 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | C ₅ H ₁₁ | H | - | - | - | - | | | | |
| 479 | Pd | 1 | 1 | Pi | Np2 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | OCH ₃ | H | - | - | - | - | | | | |
| 480 | Pd | 1 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | - | - | Cl | H | - | - | - | - | | | | |

表 38

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|--------------------------------|--------------------------------|-----------------|-----------------|------|-----|---|----|
| | | | | | | | | | | R5 | R6 | | R7 |
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | | R7 |
| 481 | Ir | 3 | 0 | Pi | FL1 | - | - | H | H | - | - | - | - |
| 482 | Ir | 3 | 0 | Pi | FL1 | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | CF ₃ | - | - | - | - |
| 483 | Ir | 3 | 0 | Pi | FL1 | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | FL4 | H | H | H | - |
| 484 | Ir | 3 | 0 | Pi | FL1 | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | Ph2 | H | H | H | H |
| 485 | Ir | 3 | 0 | Pi | FL1 | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | FL4 | H | Ph3 | H | - |
| 486 | Ir | 3 | 0 | Pi | FL1 | - | - | -CH=CH-CH=CH- | H | H | H | H | H |
| | | | | | | - | - | H | Np4 | H | - | - | - |
| 487 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 488 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | CF ₃ | - | - | - | - |
| 489 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | CF ₃ | CF ₃ | - | - | - | - |
| 490 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | CH ₃ | - | - | - | - |
| 491 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 492 | Ir | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 493 | Ir | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 494 | Ir | 3 | 0 | Pi | FL2 | C ₄ H ₉ | C ₄ H ₉ | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 495 | Ir | 3 | 0 | Pi | FL2 | Ph3 | Ph3 | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 496 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | Ph3 | -CH=CH-CH=CH- | - | - | - | - | - |
| | | | | | | - | - | H | H | - | - | - | - |
| 497 | Ir | 3 | 0 | Pi | FL2 | H | H | -CH=CH-CH=CH- | H | H | H | - | - |
| | | | | | | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| 498 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | H | H | H | - | - |
| | | | | | | CH ₃ | CH ₃ | -CH=CH-CH=CH- | - | - | - | - | - |
| 499 | Ir | 3 | 0 | Pi | FL2 | C ₂ H ₅ | C ₂ H ₅ | -CH=CH-CH=CH- | H | H | H | - | - |
| | | | | | | C ₂ H ₅ | C ₂ H ₅ | -CH=CH-CH=CH- | - | - | - | - | - |
| 500 | Ir | 3 | 0 | Pi | FL2 | C ₅ H ₁₁ | C ₅ H ₁₁ | -CH=CH-CH=CH- | H | H | H | - | - |
| | | | | | | C ₅ H ₁₁ | C ₅ H ₁₁ | -CH=CH-CH=CH- | - | - | - | - | - |
| 501 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | H | H | H | - | - |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | -CH=CH-CH=CH- | - | - | - | - | - |
| 502 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | -CH=CH-CH=CH- | H | H | H | H | H |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |

表 39

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|-----|----|---|---|------|------|-------------------------------|-------------------------------|---------------|---------|-----------------|---|----|----|
| | | | | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| 503 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | CF ₃ | H | H | H |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 504 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 505 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 506 | Ir | 3 | 0 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 507 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn6 | H | H | - | - |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 508 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np3 | H | H | - | - |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 509 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Np4 | H | - | - | - |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |
| 510 | Ir | 3 | 0 | Pi | FL2 | CH ₃ | CH ₃ | H | Tn7 | H | H | - | - |
| | | | | | | - | - | -CH=CH-CH=CH- | - | - | - | - | - |

表 40

| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | | |
|-----|-----|------|---|------|------|--------------------------------|--------------------------------|-----------------|--------------------------------|------|-------------------------------|---------|------|----|----|----|
| | | | | | | E | R'' | | | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | | | | E | | | |
| | | | | | | | | | | | | | R5 | R6 | R7 | R8 |
| G | R'' | R''' | | G | | | | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | R5 | R6 | R7 | R8 | | | | | | | | | |
| 511 | Ir | 2 | 1 | Pi | FL1 | - | - | H | H | - | - | - | - | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| 512 | Ir | 2 | 1 | Pi | FL1 | - | - | H | CF ₃ | - | - | - | - | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | |
| | | | | | | CF ₃ | - | - | | - | - | - | - | | | |
| | | | | | | CF ₃ | - | - | | - | - | - | - | | | |
| 513 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| 514 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | CF ₃ | - | - | - | - | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | |
| | | | | | | Ph2 | - | - | | H | H | H | H | | | |
| | | | | | | Ph2 | - | - | | H | H | H | H | | | |
| 515 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | H | - | - | - | - | | | |
| | | | | | | - | - | H | OC ₄ H ₉ | - | - | - | - | | | |
| | | | | | | Ph2 | - | - | | H | C ₃ H ₇ | H | H | | | |
| | | | | | | Ph2 | - | - | | H | C ₃ H ₇ | H | H | | | |
| 516 | Ir | 2 | 1 | Pi | FL2 | C ₆ H ₁₃ | C ₆ H ₁₃ | H | H | - | - | - | - | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| | | | | | | FL5 | CH ₃ | CH ₃ | | H | H | H | - | | | |
| 517 | Ir | 2 | 1 | Pi | FL2 | H | H | H | FL5 | H | H | H | - | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | |
| | | | | | | Tn5 | - | - | | H | H | - | - | | | |
| | | | | | | Tn5 | - | - | | H | H | - | - | | | |
| 518 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | H | H | - | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | |
| | | | | | | Tn6 | - | - | | H | H | - | - | | | |
| | | | | | | Tn6 | - | - | | H | H | - | - | | | |
| 519 | Ir | 2 | 1 | Pi | FL2 | Ph3 | Ph3 | H | FL5 | H | H | H | - | | | |
| | | | | | | Ph3 | Ph3 | H | H | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| | | | | | | CH ₃ | - | - | | - | - | - | - | | | |
| 520 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | Ph3 | H | FL5 | H | H | H | - | | | |
| | | | | | | CH ₃ | Ph3 | H | H | - | - | - | - | | | |
| | | | | | | CF ₃ | - | - | | - | - | - | - | | | |
| | | | | | | CF ₃ | - | - | | - | - | - | - | | | |

表 41

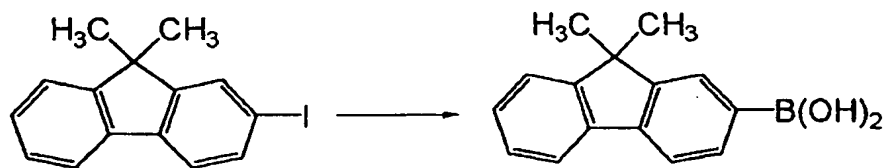
| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | | | | | |
|-----|----|----|----|------|------|-------------------------------------|-------------------------------------|-------------------------------------|---------|-------------------|---|---------|---------|------|----|----|----|
| | | | | | | E | G | | | R'' | R''' | CyC1-R3 | CyC1-R4 | R5 | R6 | R7 | R8 |
| | | | | | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | | | | | E | | | |
| G | | | | | | | | | | | | | | | | | |
| R5 | R6 | R7 | R8 | | | | | | | | | | | | | | |
| 521 | Ir | 2 | 1 | Pi | FL2 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | | | Np3 | - | - | | CH ₃ O | H | - | - | | | | |
| | | | | | | Np3 | - | - | | CH ₃ O | H | - | - | | | | |
| 522 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | | | Np4 | - | - | | F | - | - | - | | | | |
| | | | | | | Np4 | - | - | | F | - | - | - | | | | |
| 523 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OCH ₂ C ₅ F ₁₁ | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | | | Tn7 | - | - | | CH ₃ | - | - | - | | | | |
| | | | | | | Tn7 | - | - | | CH ₃ | - | - | - | | | | |
| 524 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | OC≡C-C ₇ H ₁₅ | H | H | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | | | Tn8 | - | - | | H | - | - | - | | | | |
| | | | | | | Tn8 | - | - | | H | - | - | - | | | | |
| 525 | Ir | 2 | 1 | Pi | FL2 | C ₃ H ₇ | C ₃ H ₇ | H | Tn5 | H | H | - | - | | | | |
| | | | | | | - | - | H | H | - | - | - | - | | | | |
| | | | | | | Pe2 | - | - | | H | - | - | - | | | | |
| | | | | | | Pe2 | - | - | | H | - | - | - | | | | |
| 526 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL4 | H | Ph3 | H | - | | | | |
| | | | | | | - | - | H | Ph2 | H | H | H | H | | | | |
| | | | | | | Pi2 | - | - | | H | H | - | - | | | | |
| | | | | | | Pi2 | - | - | | H | H | - | - | | | | |
| 527 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | FL5 | H | Ph3 | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | Ph2 | H | H | H | H | | | | |
| | | | | | | Pi3 | - | - | | CH ₃ | CH ₃ | H | H | | | | |
| | | | | | | Pi3 | - | - | | CH ₃ | CH ₃ | H | H | | | | |
| 528 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | FL5 | H | H | H | - | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | | | FL4 | - | - | | H | H | H | - | | | | |
| | | | | | | FL4 | - | - | | H | H | H | - | | | | |
| 529 | Ir | 2 | 1 | Pi | FL2 | CH ₃ | CH ₃ | H | Ph2 | H | FL5 | H | H | | | | |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - | | | | |
| | | | | | | FL5 | C ₂ H ₅ | C ₂ H ₅ | | H | H | H | - | | | | |
| | | | | | | FL5 | (CH ₂) ₅ Ph3 | (CH ₂) ₅ Ph3 | | H | H | H | - | | | | |
| 530 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | H | - | - | - | - | | | | |
| | | | | | | C ₈ H ₁₇ | C ₈ H ₁₇ | FL5 | H | H | H | H | - | | | | |
| | | | | | | DBF2 | - | - | | H | H | H | - | | | | |
| | | | | | | DBF2 | - | - | | H | H | H | - | | | | |

表 42

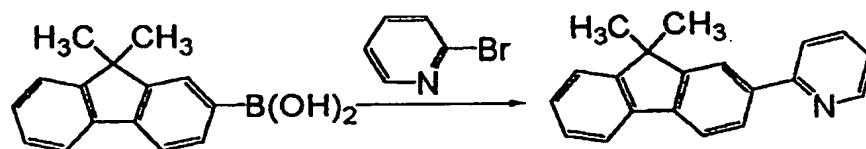
| No | M | m | n | CyN1 | CyC1 | R | R' | CyN1-R1 | CyN1-R2 | CyN1 | | | |
|---------------------------------|---------------------------------|----|-----------------|------|------|-----------------|-----------------|---------|---------|------|-----|-----|---------------------------------|
| | | | | | | E | R'' | R''' | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | CyC1 | | | |
| | | | | | | | | | | R5 | R6 | R7 | R8 |
| | | | | | | | | | | G | | | |
| R5 | R6 | R7 | R8 | | | | | | | | | | |
| 531 | Ir | 2 | 1 | Pi | Ph1 | - | - | H | Ph2 | H | FL5 | H | H |
| | | | | | | CH ₃ | CH ₃ | H | H | - | - | - | - |
| | | | | | | DBT3 | - | - | | H | H | H | - |
| | | | | | | DBT3 | - | - | | H | H | H | - |
| | | | | | | 532 | Rh | 2 | | 1 | Pi | FL3 | CH ₃ |
| - | - | H | H | - | - | | | | - | | | | - |
| CH ₃ | - | - | | - | - | | | | - | | | | - |
| CH ₃ | - | - | | - | - | | | | - | | | | - |
| 533 | Rh | 2 | | 1 | Pi | | | | DBF1 | | | | CH ₃ |
| | | | - | | | - | H | H | | - | - | - | - |
| | | | CF ₃ | | | - | - | | | - | - | - | - |
| | | | CF ₃ | | | - | - | | | - | - | - | - |
| | | | 534 | | | Rh | 2 | | | 1 | Pi | FL1 | - |
| CH ₃ | CH ₃ | H | | H | - | | | - | - | | | | - |
| Qn2 | - | - | | | H | | | H | - | | | | - |
| Qn2 | - | - | | | H | | | H | - | | | | - |
| 535 | Rh | 2 | | | 1 | | | Pi | Np2 | | | | - |
| | | | - | - | | H | H | | | - | - | - | - |
| | | | Np3 | - | | - | | | | H | H | - | - |
| | | | Np3 | - | | - | | | | H | H | - | - |
| | | | 536 | Pt | | 1 | | | | 1 | Pi | FL2 | C ₃ H ₇ |
| - | - | H | | | H | | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |
| 537 | Pt | 1 | | | | | 1 | Pi | FL2 | | | | C ₅ H ₁₁ |
| | | | - | - | H | H | | | | - | - | - | - |
| | | | CF ₃ | - | - | | | | | - | - | - | - |
| | | | CF ₃ | - | - | | | | | - | - | - | - |
| | | | 538 | Pd | 1 | | | | | 1 | Pi | FL2 | C ₁₅ H ₃₁ |
| C ₁₅ H ₃₁ | C ₁₅ H ₃₁ | H | | | | H | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |
| 539 | Pd | 1 | | | | | 1 | Pi | FL2 | | | | CH ₃ |
| | | | - | - | H | H | | | | - | - | - | - |
| | | | CF ₃ | - | - | | | | | - | - | - | - |
| | | | CF ₃ | - | - | | | | | - | - | - | - |
| | | | 540 | Ir | 1 | | | | | 2 | Pi | Tn4 | - |
| CH ₃ | CH ₃ | H | | | | H | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |
| CH ₃ | - | - | | | | | - | - | - | | | | - |

此后，根据实施例更具体地描述本发明。

实施例 1 (实施例化合物 No. 23 的合成)

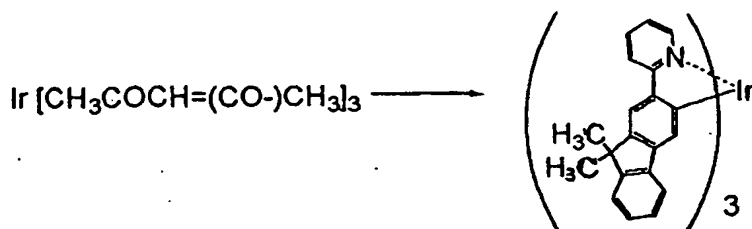


在 30 升三颈烧瓶中，在搅拌条件下，在氩气流气氛中，将 307.3g (960mM) 2-碘-9,9-二甲基芴和 10 升干燥 THF (四氢呋喃) 放入和冷却到 -72 到 70℃。向混合物中，在 1 小时内滴加正丁基锂在己烷中的 1.6M 溶液，随后进一步在所述温度下搅拌 2 小时。其后，在搅拌条件下，在 -73 到 -71℃ 下，向体系中，在 2 小时内滴加 209.5g (2016mM) 硼酸三甲酯在 1.3 升干燥 THF 中的溶液。将反应混合物在冰水浴中静置过夜。向该混合物中，在 0.5 小时内，在 0-7℃ 下，加入 1.6 升 4N 盐酸，随后在室温下搅拌 1 小时和以甲苯萃取。以饱和盐水洗涤有机层，随后在减压下蒸馏出溶剂以获得残余物。向残余物中，将己烷加入和在加热条件下加热，随后冷却以沉淀晶体。通过过滤回收晶体和通过硅胶柱色谱 (洗脱剂: 甲苯/乙酸乙酯=1/1) 精制，随后从氯仿-己烷混合物溶剂，甲苯，乙酸乙酯-甲苯-THF 混合物溶剂，和甲苯进行连续再结晶，以获得 32.0g 的 2-(9,9-二甲基芴基)硼酸 (无色晶体) (收率: 14.0%)。



在 300ml 三颈烧瓶中，在室温下，在氩气流下，将 8.5g (53.8mM) 2-溴代吡啶，12.8g (53.8mM) 2-(9,9-二甲基芴基)硼酸，55ml 甲苯，27ml 乙醇和 55ml 的 2M-碳酸钠水溶液放入和搅拌，和向其中加入 1.97g (1.70mM) 四(三苯基膦)合钯(0)。其后，在氩气流下，在搅拌条件

下进行回流 5.5 小时。反应后，通过添加冷水和甲苯冷却和萃取反应混合物。以水洗涤有机层直到中性，和在减压下除去溶剂以获得残余物。通过硅胶柱色谱(洗脱剂：甲苯/THF=10/1)和硅胶柱色谱(洗脱剂：己烷/乙酸乙酯=8/1)继续精制残余物，以获得 12.2g 的 2-{2-(9,9-二甲基芴基)}吡啶(淡棕色粘性液体)(收率:83.6%)。

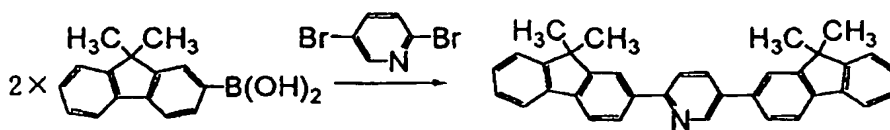


在 100ml 四颈烧瓶中，将 50ml 甘油放入并在 130-140℃ 下，在搅拌和以氮气鼓泡条件下加热 2 小时。然后，将甘油通过静置冷却到 100℃，加入 1.69g (6.23mM) 的 2-{2-(9,9-二甲基芴基)}吡啶和 0.50g (1.02mM) 乙酰丙酮合铱(III)，随后在搅拌和氮气流条件下，在 176-219℃ 加热 5 小时。将反应产物冷却到室温和注入 300ml 的 1N 盐酸以形成沉淀物，将沉淀物过滤和以水洗涤，随后在减压下，在 100℃ 下干燥 5 小时。采用硅胶柱色谱，以氯仿作为洗脱剂，精制沉淀物，以获得 0.17g (收率=21.3%) 的橙色粉状三 [2-(9,9-二甲基芴-2-基)吡啶-C³, N] 合铱(III)。根据 MALDI-TOF MS (矩阵 (Matrix) 辅助激光解吸离子化-飞行时间 (time of flight) 质谱)，化合物显示 1003.4 的 M⁺ (通过除去 1 个电子而形成的相应阳离子的质量数)。

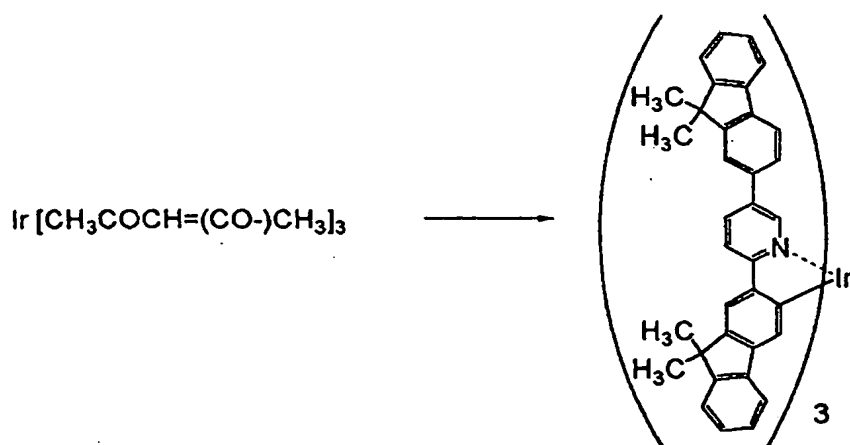
化合物的甲苯溶液显示 λ_{\max} (最大发射波长)=545nm 和量子收率为 0.23 的光致发光光谱。

化合物(实施例化合物 No. 23)显示更好的合成收率和量子收率，因此是本发明中最适合的发光材料。

实施例 2 (实施例化合物 No. 43 的合成)



在 100ml 三颈烧瓶中, 在室温下, 在氮气流下, 将 1.18g (4.98mM) 2,5-二溴代吡啶, 3.57g (15.0mM) 实施例 1 中制备的 2-(9,9-二甲基芴基)硼酸, 10ml 甲苯, 5ml 乙醇和 10ml 的 2M-碳酸钠水溶液放入和搅拌, 和向其中加入 0.35g (0.30mM) 四(三苯基膦)钯(0)。其后, 在氮气流下, 在搅拌条件下进行回流 12 小时。在反应完成之后, 将反应产物在冰浴中冷却以沉淀晶体, 然后将晶体过滤和以水洗涤。向晶体中, 在室温下, 在搅拌条件下, 将 100ml 甲醇加入和洗涤, 然后通过过滤而回收。通过硅胶柱色谱(洗脱剂: 氯仿)精制获得的晶体, 以获得 2.10g (收率=91.0%) 2,5-双{2-(9,9-二甲基芴基)}吡啶(无色晶体)。



在 100ml 四颈烧瓶中, 将 50ml 甘油放入和在 130-140℃下, 在搅拌和以氮气鼓泡条件下加热 2 小时。然后, 将甘油通过静置冷却到 100℃, 加入 1.85g (3.99mM) 2,5-双{2-(9,9-二甲基芴基)}吡啶和 0.40g (0.82mM) 乙酰丙酮合铱(III), 随后在搅拌和氮气流条件下, 在 180-235℃回流 5 小时。将反应产物冷却到室温和注入 300ml 的 1N 盐酸以形成沉淀物, 将沉淀物过滤和以水洗涤, 随后在减压下, 在 100℃下干燥 5 小时。采用硅胶柱色谱, 以氯仿作为洗脱剂, 精制沉淀物, 和从氯仿-甲醇混合物再结晶, 以获得 0.10g (收率=7.7%) 的红色粉状三[2,5-双(9,9-二甲基芴-2-基)吡啶-C³,N]铱(III)。根据 MALDI-TOF MS, 化合物显示 1589.6 的 M⁺。

化合物的甲苯溶液显示λ_{max}(最大发射波长)=591nm 和量子收率为

0.12 的光致发光光谱。

实施例 3-11

以如下方式, 制备具有如图 1B 所示结构的每个发光器件。

在 1.1mm 厚的玻璃衬底(透明衬底 15)上, 通过溅射形成 ITO(氧化铟锡)的 100nm 厚膜(透明电极 14), 随后通过图案化以形成条电极, 它包括 100 条线, 每条宽度为 100nm 和相邻线的间隔(spacing)为 10nm(即, 电极间距(pitch)为 110nm)。

在形成了 ITO 的衬底上, 在真空室(10^{-4} Pa)中使用电阻加热, 通过真空(气相)沉积, 相继地形成如下所示的三个有机层和两个金属电极层。

有机层 1(空穴传递层 13)(40nm): α -NPD

有机层 2(发光层 12)(30nm): CBP: 金属配合物(表 45 所示的金属配位化合物)(95:5, 按重量计)的共沉积膜

有机层 3(电子传递层 16)(40nm): Alq3

金属电极层 1(金属电极 11)(15nm): Al-Li 合金(Li=1.8wt. %)

金属电极层 2(金属电极 11)(100nm): Al

以上沉积的金属电极层 1 和 2(Al-Li 层和 Al 层)含有条电极图案, 包括 100 条线, 每个宽度为 100nm 和间隔 10nm(即, 电极间距为 110nm), 和其排列使得条电极图案与 ITO 电极的图案以直角交叉, 以形成像素矩阵, 每个像素具有 3mm^2 的有效电极面积, 包括在引出(lead-out)部分集束在一起的 20 个 ITO 线和在引出部分集束在一起的 15 个 Al(Al-Li)线。

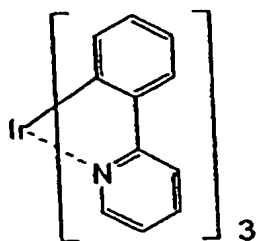
将每个这样制备的发光器件从真空室取出, 和在干燥氮气气氛中对它们进行连续通电(电流通过)测试, 以除去器件退化因素, 如氧和水分(水含量)。

通过向含有 ITO(透明)电极(作为阳极)和 Al(金属)电极(作为阴极)的发光器件, 连续地施加在 $70\text{mA}/\text{cm}^2$ 恒定电流密度下的电压, 而进行连续通电测试, 随后测量随时间的发射亮度(亮度), 以确定要求将初始亮度($60\text{--}220\text{cd}/\text{m}^2$)降低到其 1/2 所需的时间(亮度一半寿命)。

结果见此后出现的表 45。

对比例 1

以实施例 3-11 相同的方式, 制备并评价对比发光器件, 区别在于将 Ir 配合物(表 45 所示的金属配位化合物)变成如下所示的 Ir-苯基嘧啶配合物($\text{Ir}(\text{ppy})_3$)。



结果也见下表 45。

表 45

| 实施例 No. | 化合物 No. | 亮度一半寿命(Hr) |
|---------|---------------------------|------------|
| 实施例 3 | 6 | 700 |
| 实施例 4 | 23 | 850 |
| 实施例 5 | 43 | 950 |
| 实施例 6 | 54 | 800 |
| 实施例 7 | 72 | 850 |
| 实施例 8 | 99 | 750 |
| 实施例 9 | 118 | 600 |
| 实施例 10 | 153 | 700 |
| 实施例 11 | 440 | 650 |
| 对比例 1 | $\text{Ir}(\text{ppy})_3$ | 350 |

从表 45 是显然的, 与使用 $\text{Ir}(\text{ppy})_3$ 的常规发光器件相比, 使用根据本发明通式(1)金属配位化合物的发光器件提供更长的亮度一半寿命, 因此导致具有高耐用性(亮度稳定性)的 EL 器件, 该耐用性基于本发明通式(1)金属配位化合物的良好稳定性。

实施例 12

以如下方式, 制备如图 2 所示的彩色有机 EL 显示设备。

有源矩阵衬底具有基本相似于 U. S. 专利 No. 6, 114, 715 中描述结构的平面结构。

具体地, 在 1.1mm 厚玻璃衬底上, 以通常的方式形成多晶硅的顶栅型 TFTs 和在其上, 形成具有用于电连接的接触孔、像素电极(阳极)在各自的源区域的变平膜, 因此制备具有 TFT 电路的有源矩阵衬底。

在有源矩阵衬底上, 以规定的图案, 形成具有大功函数的 ITO 的 700nm 厚像素电极(正极)。在 ITO 电极上, 采用坚固掩膜(hard mask), 通过真空沉积, 相继地形成规定的有机层和 100nm 厚 Al 电极(阴极), 随后形成图案以形成具有彩色像素的矩阵(128×128 像素)。

相应于三个彩色像素(红(R)绿(G)蓝(B))的各自有机层由如下层组成。

<R 像素区域>

α -NPD(40nm)/CBP: 实施例化合物 No. 487(93:7, 按重量计)
(30nm)/BCP(20nm)/Alq3(40nm)

<G 像素区域>

α -NPD(50nm)/Alq3(50nm)

<B 像素区域>

α -NPD(50nm)/BCP(20nm)/Alq3(50nm)

当驱动这样制备的彩色有机 EL 显示设备时, 可以稳定地显示所需的彩色图象, 具有良好的图象质量。

实施例 13(实施例化合物 No. 24 的合成)

以实施例 1 中相同的方式, 容易合成如下的化合物, 区别在于使用 2-氯-5-三氟甲基吡啶(由 Tokyo Kasei Kogyo K. K. 制造)代替实施例 1 中的 2-溴代吡啶。

三[2-(9, 9-二甲基芴-2-基)-5-三氟甲基吡啶-C³, N]铱(III)。

实施例 14(实施例化合物 No. 25 的合成)

以实施例 1 中相同的方式, 容易合成如下的化合物, 区别在于使用 2-氯-4, 5-双(三氟甲基)吡啶(由 Oakwood Products Inc. 制造)代替实施例 1 中的 2-溴代吡啶。

三[2-(9,9-二甲基苄-2-基)-4,5-双(三氟甲基)吡啶-C³,N]铱(III).
实施例 15(实施例化合物 No. 26 的合成)

以实施例 1 中相同的方式,容易合成如下的化合物,区别在于使用 2-氯-5-甲基吡啶(由 Aldrich Co. 制造)代替实施例 1 中的 2-溴代吡啶.

三[2-(9,9-二甲基苄-2-基)-5-甲基吡啶-C³,N]铱(III).

实施例 16(实施例化合物 No. 27 的合成)

以实施例 1 中相同的方式,容易合成如下的化合物,区别在于以如在日本专利申请(Tokuhyo Hei)11-510535(相应于 U.S. 专利 No. 5,708,130)32 页实施例 1 中所述方法的相同方式,从 2-溴代苄和碘乙烷合成 2-溴-9,9-二乙基苄,和以(本发明)实施例 1 中相同的方式,将其改性成 2-(9,9-二乙基苄基)硼酸酯,随后与 2-溴代吡啶反应以合成 2-{2-(9,9-二乙基苄基)}吡啶,和然后以实施例 1 中相同的方式,与乙酰丙酮合铱(III)反应.

三[2-(9,9-二乙基苄-2-基)吡啶-C³,N]铱(III).

实施例 17(实施例化合物 No. 29 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘丙烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷.

三[2-(9,9-二(1-丙基)苄-2-基)吡啶-C³,N]铱(III).

实施例 18(实施例化合物 No. 30 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘丁烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷.

三[2-(9,9-二(1-丁基)苄-2-基)吡啶-C³,N]铱(III).

实施例 19(实施例化合物 No. 31 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘戊烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷.

三[2-(9,9-二(1-戊基)苄-2-基)吡啶-C³,N]铱(III).

实施例 20(实施例化合物 No. 32 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘己烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷.

三[2-(9,9-二(1-己基)苈-2-基)吡啶- C^3 ,N]铱(III)。

实施例 21(实施例化合物 No. 33 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘庚烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷。

三[2-(9,9-二(1-庚基)苈-2-基)吡啶- C^3 ,N]铱(III)。

实施例 22(实施例化合物 No. 34 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘辛烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷。

三[2-(9,9-二(1-辛基)苈-2-基)吡啶- C^3 ,N]铱(III)。

实施例 23(实施例化合物 No. 35 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-碘癸烷(由 Aldrich Co. 制造)代替碘乙烷,和使用 2-氯-5-三氟甲基吡啶(由 Tokyo Kasei Kogyo K. K. 制造)代替实施例 16 中的 2-溴代吡啶。

三[2-(9,9-二(1-癸基)苈-2-基)-5-三氟甲基吡啶- C^3 ,N]铱(III)。

实施例 24(实施例化合物 No. 37 的合成)

以实施例 16 中相同的方式,容易合成如下的化合物,区别在于使用 1-溴二十烷(由 Aldrich Co. 制造)代替实施例 16 中的碘乙烷。

三[2-(9,9-二(1-二十烷基)苈-2-基)吡啶- C^3 ,N]铱(III)。

实施例 25(实施例化合物 No. 44 的合成)

以实施例 2 中相同的方式,容易合成如下的化合物,区别在于使用 2-(9,9-二乙基苈基)硼酸代替实施例 2 中的 2-(9,9-二甲基苈基)硼酸。

三[2,5-双(9,9-二乙基苈-2-基)吡啶- C^3 ,N]铱(III)。

实施例 26(实施例化合物 No. 45 的合成)

以实施例 2 中相同的方式,容易合成如下的化合物,区别在于使用 2-(9,9-二(1-戊基)苈基)硼酸代替实施例 2 中的 2-(9,9-二甲基苈基)硼酸。

三{2,5-双(9,9-二(1-戊基)苈-2-基)吡啶- C^3 ,N}铱(III)。

实施例 27(实施例化合物 No. 47 的合成)

以实施例 2 中相同的方式,容易合成如下的化合物,区别在于使用

2-(9,9-二(1-十五烷基)芴基)硼酸代替实施例 2 中的 2-(9,9-二甲基芴基)硼酸。

三{2,5-双(9,9-二(1-十五烷基)芴-2-基)吡啶- C^3 ,N}铱(III)。

实施例 28(实施例化合物 No. 146 的合成)

以实施例 1 中相同的方式,容易合成如下的化合物,区别在于使用二苯并呋喃-4-硼酸(由 Frontier Scientific Inc. 制造)代替实施例 1 中的 2-(9,9-二甲基芴基)硼酸。

三[2-(二苯并呋喃)-4-基]吡啶- C^3 ,N]铱(III)。

实施例 29(实施例化合物 No. 147 的合成)

以实施例 1 中相同的方式,容易合成如下的化合物,区别在于使用二苯并噻吩-4-硼酸(由 Frontier Scientific Inc. 制造)代替实施例 1 中的 2-(9,9-二甲基芴基)硼酸。

三[2-(二苯并噻吩)-4-基]吡啶- C^3 ,N]铱(III)。

实施例 30(实施例化合物 No. 149 的合成)

以实施例 2 中相同的方式,容易合成如下的化合物,区别在于使用二苯并呋喃-4-硼酸(由 Frontier Scientific Inc. 制造)代替实施例 1 中的 2-(9,9-二甲基芴基)硼酸。

三[2,5-双(二苯并呋喃)-4-基]吡啶- C^3 ,N]铱(III)。

实施例 31(实施例化合物 No. 150 的合成)

以实施例 2 中相同的方式,容易合成如下的化合物,区别在于使用二苯并噻吩-4-硼酸(由 Frontier Scientific Inc. 制造)代替实施例 2 中的 2-(9,9-二甲基芴基)硼酸。

三[2,5-双(苯并噻吩)-4-基]吡啶- C^3 ,N]铱(III)。

实施例 32

以如下方式,制备如图 1C 所示的有机 EL 器件。

在形成于 1.1mm 厚无碱玻璃衬底上的 100nm 厚图案化的 ITO 电极(阳极)上,以 0.1nm/sec 的沉积速率,通过真空沉积(10^{-4} Pa),形成 α -NPD 的 40nm 厚电荷传递层。通过控制沉积容器的加热条件,以 0.1nm/sec 的沉积速率(对于 CBP)和以 0.09nm/sec 的沉积速率(对于铱配合物)通过共

真空沉积,在电荷传递层上形成 CBP:实施例化合物 No. 23 铱配合物(93:7 以重量计)的 40nm 厚发光层(共沉积膜)。在发光层上,以 0.1nm/sec 的沉积速率,通过真空沉积,形成 BCP(浴铜灵)的 40nm 厚防止激发子扩散层,和在防止激发子扩散层上,以 0.1nm/sec 的沉积速率,通过真空沉积,形成 Alq3 的 20nm 厚电子传递层。其后,在电子传递层上,以 1nm/sec 的沉积速率,通过真空沉积,形成 150nm 厚铝电极(阴极)。

由此制备的有机 EL 器件显示这样的 EL 光谱: $\lambda_{\max}=545\text{nm}$; 在 100cd/m^2 的亮度下,发光效率为 12.4 lm/W ; 在 600cd/m^2 的亮度下,发光效率为 13.6 lm/W 。

实施例 33

以实施例 32 中的相同方式,制备和评价有机 EL 器件,区别在于使用三[2,5-双(9,9-二甲基芴-2-基)吡啶- C^3,N]铱(III)(实施例化合物 No. 43)代替在实施例 1 中合成的三[2-(9,9-二甲基芴-2-基)吡啶- C^3,N]铱(III)(实施例化合物 No. 23)。

由此制备的有机 EL 器件显示这样的 EL 光谱: $\lambda_{\max}=590\text{nm}$; 在 100cd/m^2 的亮度下,发光效率为 2.4 lm/W ; 在 300cd/m^2 的亮度下,发光效率为 1.9 lm/W 。

实施例 34(实施例化合物 No. 54 的合成)

以实施例 1 中相同的方式,容易合成如下的化合物,区别在于使用 4-苯基-1-溴代吡啶(由加拿大 General Intermediates 制造)代替实施例 1 中的 2-溴代吡啶。

三[2-(9,9-二甲基芴-2-基)-4-苯基吡啶- C^3,N]铱(III)。

如上所述,根据本发明,特征在于以通式(5)芳族基团作为部分结构的通式(1)的金属配位化合物是显示高发射量子效率的优异材料。使用通式(1)金属配位化合物作为发光中心材料的本发明电致发光器件(发光器件)是优异的器件,它不仅仅允许高效率的发光,而且保持高亮度较长的时间和显示极小的由于电流通过的退化。此外,使用本发明电致发光器件的显示设备呈现优异的显示性能。

说明书附图

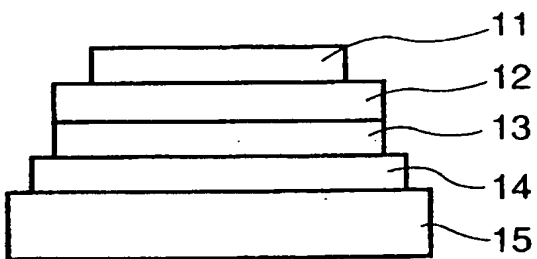


图1A

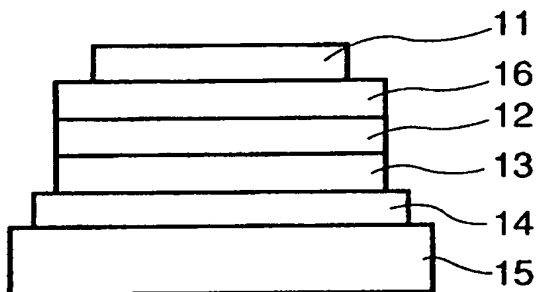


图1B

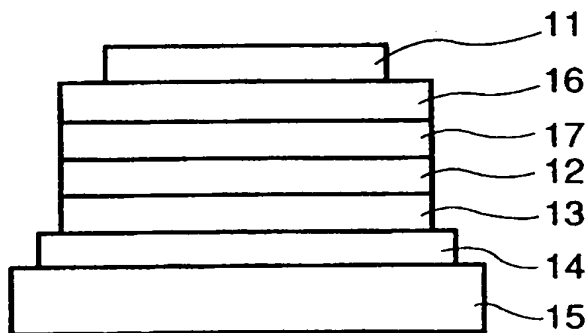


图1C



图 2